

Stamping Out Hog Cholera

Price 50¢



BY DR. J. W. CONNORWAY
OF MISSOURI EXPERIMENT STATION
COLUMBIA, MO.

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COLUMBIA, MO.

A Word to Farmers

We believe we can safely say that this booklet contains a more complete program for fighting Hog Cholera than has ever before been presented to the farmers of the Corn Belt. The amount of good you and your neighbors will derive from it, however, depends entirely upon what action you take on the advice herein contained. As Dr. Connaway aptly says, the eradication of Cholera **"is primarily the farmer's problem."** So long as there is no concert of action—so long as farmers are at the mercy of careless neighbors—just so long will this pestilence exact its annual toll of millions of dollars.

The moment these booklets have been distributed in your neighborhood, steps should be taken for immediate action. Perhaps the best way will be to form an Executive Committee composed of 15 or 20 high-class farmers. Then let this Committee call a mass meeting of farmers in the town from whence the booklets were mailed out and at this mass meeting plans should be perfected to organize an "Anti-Hog-Cholera Club" in every school district in the surrounding territory. As soon as the school district work begins, a Membership Committee should be appointed in each district and the committee should see to it that every farmer within the district joins the Club. If there are districts which are slow to act, pressure should be brought to bear in order that there may be no "infection spots" left. In this way, the "clean up" work will soon reach out in every direction and the results are certain to save hundreds of hogs. If there is a County Agent in your county, naturally he should lead in the organization work. Also, possibly the Agricultural College or State Veterinary Department may be able to send you a good man to assist. However, if such outside aid is not available **farmers should proceed on their own initiative!**—for the campaign herein outlined comes from one of the greatest Hog Cholera authorities in the United States and is so simple that the farmers of any community can easily put it into operation themselves. **The main thing is to act quickly and thoroughly!** Doubtless also, the Bank or Commercial Club which mailed out these booklets will be glad to render every possible assistance. The great purpose which has prompted us in publishing this booklet is to give farmers a program for fighting Hog Cholera which can be put into immediate effect in any community without outside assistance—for this task is so herculean that no Agricultural College or State Veterinary Department can possibly furnish half enough men to lead this "clean up" and "prevention" work which, in the last analysis, must depend upon farmers themselves. As in many other things, the actual beginning is more than half the battle. All signs point to a bad cholera season throughout the Corn Belt. Undoubtedly the floods of the past summer have carried the contagion into many communities which were free from it last year. Again, the lack of hot sunshine will make the germs unusually virile. There is therefore not a moment to lose. The splendid results in Johnson County described by Mr. Ellis on pages 42, 43 and 44 can be obtained in any community where similarly aggressive organization work is put into effect. **The main thing is to act!** Once the school district Clubs have been organized, weekly meetings should be held until the situation is well in hand. If something comes up which you do not understand, write at once to your Agricultural College or State Veterinary Department.

In conclusion, we feel sure you will appreciate the kindly interest of those who, at considerable expense, have placed these booklets in the hands of yourself and the other farmers of your community and whose only purpose is to contribute their share toward a happier and more prosperous farm life. The time has come when all interests and forces must join hands in the great crusade for better farming methods upon which the welfare of the entire Nation so completely depends.

THE MISSOURI FARMER,
Columbia, Mo.

Stamping Out Hog Cholera

By

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Supplemented with articles on Methods of Breeding, Feeding and
Caring for Swine by F. G. King, Indiana Experiment
Station, and L. A. Weaver, Missouri
Experiment Station

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A Word to Swine Raisers

Few men realize the enormous loss the live stock industry sustains annually from disease, most of which is preventable under proper sanitary measures and treatment. According to Secretary of Agriculture, D. F. Houston, the swine raisers of the United States lost in 1913 "over 6,000,000 hogs valued at more than \$60,000,000." (See Year Book 1914, p. 19). For some reason there has been an enormous increase in hog cholera losses. According to the same source of information, Secretary of Agriculture, Jas. Wilson, in his report for 1912 (see Yearbook 1912, p. 169) estimates the annual loss from cholera at \$18,000,000. These official figures are alarming to those interested in the swine industry and bear in mind this increase in hog cholera has been going on in spite of the increased efforts of the United States Department of Agriculture and about twenty-eight state departments which are trying to save the hogs. In the absence of other causes it seems safe to assume that the cause for this abnormal increase of hog cholera is due the planting of the seeds of the disease by the use of virus in the vaccination of hogs.

The Department of Agriculture estimates the number of hogs, value and losses for one year from all sources for the eight leading states as follows:

	No. Hogs in State	Total Value	Loss from Disease
Iowa	8,720,000	\$104,640,000	\$16,742,000
Illinois	4,315,000	45,308,000	6,343,050
Missouri	4,087,000	34,740,000	6,079,412
Nebraska	3,798,000	43,297,000	4,752,692
Indiana	3,709,000	36,348,000	5,452,230
Ohio	3,399,000	36,709,000	3,156,991
Kansas	2,611,000	27,154,000	3,258,528
Texas	2,493,000	20,941,000	942,354
United States	61,178,000	603,109,000	\$66,439,470

The above losses are from all sources but as cholera accounts for about 90 per cent of the total losses of hogs it leaves the loss of the whole country for one year, from cholera alone at \$60,000,000.

As further evidence that hog cholera has made an abnormal increase during the period that simultaneous vaccination has been developed we submit the following official figures showing the number of hogs received and the number condemned on account of cholera at the markets where Government inspectors are maintained:

Year	No. Hogs Received	Cholera-Hogs Condemned
1910	27,731,627	7,677
1911	29,920,261	10,721
1912	34,966,378	56,931
1913	32,287,537	88,547
1914	33,289,705	116,107

The above figures show only a normal increase in the number of hogs inspected for the five years but they show an alarming increase in the number of cholera cases—more than 1500 per cent. What other intelli-

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gent reason can be given for this abnormal increase in cholera except that we have been deliberately sowing the seeds of hog cholera by the use of virus in the simultaneous process of vaccination?

THE MISSOURI FARMER believes the best thing farmers can do is to put prejudice aside and unite their efforts to get rid of cholera. It



Dr. J. W. Connaway

does not seem reasonable that we can ever get entirely rid of this very contagious disease so long as we keep on scattering infection by the use of the virus method now used and recommended by so many veterinarians. The virus method may protect the man who uses it persistently but it exposes his neighbors' hogs and many new outbreaks are traced to this method.

The serum-sanitation method outlined in this book by Dr. J. W. Connaway, Veterinary Department, College of Agriculture, University of Missouri, is along the same lines as those adopted by the National and various state boards of health in the control of contagious and infectious diseases among people.

Dr. Connaway has spent the best years of his life in developing this method of hog cholera control. Hundreds of tests and experiments have been made in the veterinary laboratories of the State University, thousands of hogs have been used for making the experiments, and in addition Dr. Connaway has visited many counties where hog cholera was raging and has studied the various ways by which the disease is spread from farm to farm. He has organized the farmers in several counties in Missouri that were at the time badly infested with cholera, into "Anti-Hog-Cholera Clubs" where his methods of sanitation and a limited use of serum have been thoroughly tried out with the result that hog cholera has been practically wiped out of these counties. **What has been done in these few counties can be done in any county or state in the Hog Belt by adopting the plan set forth in this book.**

No treatise on hog cholera has ever before been written by a man so competent to give correct advice as the author of this book. In co-operation with the Texas Experiment Station Dr. Connaway's first great work was in perfecting the process of immunization of cattle against Texas Fever which enabled breeders to immunize their cattle and ship them into tick-infested areas with perfect safety. Aside from Dr. Connaway's experience as a veterinarian in the Missouri Experiment Station and among the live stock owners of the state he has studied in the leading universities of Europe, and because of the unselfish interest he has shown in the welfare of farmers and live stock owners, what he has to say in the following pages should be accepted as thoroughly reliable and most valuable advice to follow.

THE PUBLISHER.

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How to Get Rid of Hog Cholera

J. W. CONNAWAY, D. V. S., M. D., VETERINARY DEPARTMENT, COLLEGE
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A plan to get rid of hog cholera and to prevent its recurrence on the farms of Missouri was formulated some two years ago by the Veterinary Department, in co-operation with the Farm Management Department of the University, and has been put into practical operation in several counties of the State with good results.

This plan will be extended to other counties of the State, as rapidly as possible, through the newly organized department of Agricultural Extension by means of which the departments of Veterinary Science, Farm Management and Animal Husbandry have been co-ordinated for more effective team-work, on the educational and demonstration phases of the problem. This plan provides for the co-operation of state and local police agencies, when the enforcement of official police measures are required. Fortunately experience has shown that drastic measures are rarely necessary. The plan which was formulated is simply an adaptation to stock farm conditions of old and well established principles and practices of sanitation that long experience has shown to be essential and efficacious in the control of epidemics of disease affecting the human family.

Let us consider for a moment what would be done if smallpox should break out in your neighborhood; or if scarlet fever or diphtheria should attack some child attending your schools. The first thing that would be done would be to isolate the infected person in such a manner as to prevent the spread of the disease. The patient would be kept in strict quarantine until the disease runs its course and until no danger exists from the release of the patient. All persons who have been exposed would be either quarantined, or disinfected and kept under close surveillance, until the incubation period of the disease has passed and they are found to be free from the disease and not dangerous as carriers of the infection. Visitors, though immune to the disease, would not be admitted to the isolation hospital where infected patients are being cared for on account of the risk of carrying away infection on their clothing. The people of the neighborhood would have prompt notification of the presence of the disease by spread of the news from neighbor to neighbor or through the public press; besides, the infected houses and quarantine quarters would be marked with yellow or red flags, or with placards to give warning to the public of the presence of a dangerous, infectious disease. During the course of the disease, proper measures of disinfection would be applied, particularly to all excretions. And before the quarantine of the premises is raised, the patient and the clothing, bedding, utensils, and the building would be properly disinfected to prevent the spread of the disease. And where railroad coaches, cabs, depots, hotels, school houses or other public buildings have been exposed to the infection, these would also be thoroughly disinfected.

In addition to the foregoing measures vaccines or serums are employed to some extent in certain diseases as in small-pox and diphtheria.

And it cannot be denied that such preventive and curative measures have been of inestimable value in the saving of human life. It must be remembered, however, that some infections, for which no vaccines exist, have been controlled in an effective manner by sanitation alone. The workers who dug the Panama Canal were saved from yellow fever and malaria by sanitation and not by vaccination. Bubonic Plague was eradicated from our coast cities without vaccination. In the control of typhoid fever, health officers are still zealous in applying sanitary measures, notwithstanding the efficacy of anti-typhoid vaccination. Public health will still demand a pure water supply, uncontaminated by cess-pool drainage; and still demand a clean, nourishing, healthful food supply.

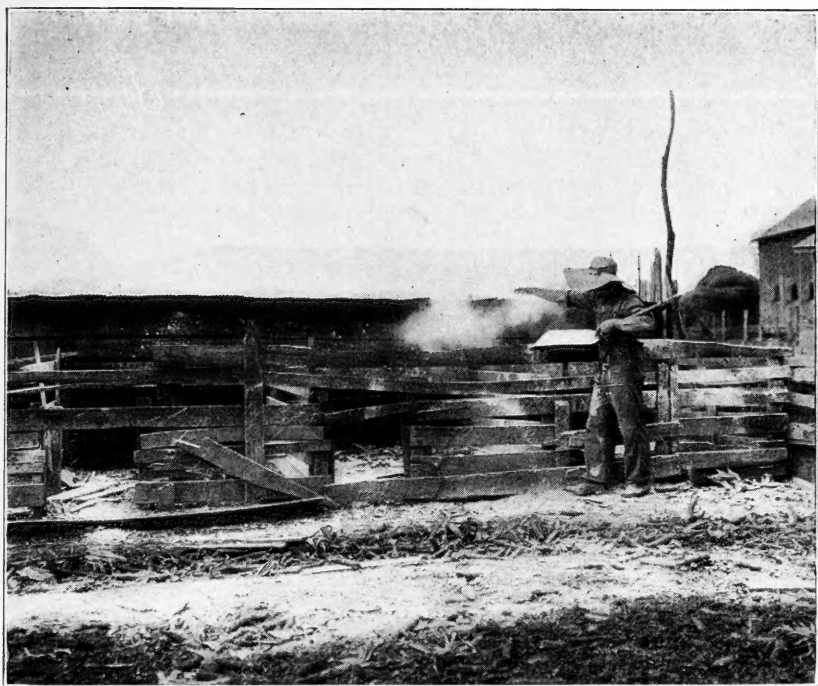
Sanitary measures are employed to prevent the parasitic infestation of children and adults by such parasites as tape worms and hook worms and the common round-worms which lower the vitality of the human host and lessen the resistance to infectious disease.

The modern science of Sanitary Engineering is an aid to the maintenance of human health, and the prevention of epidemic contagions; for it helps in building dwellings and public buildings that are healthful as well as convenient, and the more that public attention is directed to healthful housing the simpler becomes the problem of the control of infectious diseases.

Success in the control and eradication of epidemics of human maladies has not been the work of a day. It has been of slow development, and has been built upon scientific investigations that have given to the world a better knowledge of the nature of infections and how to control them. It has also come from the popularization of knowledge concerning these matters; and the value of the latter cannot be over-estimated, for in this way only can a forceful community-sentiment be developed that will result in proper organization and co-operation to do the things that should be done. For in the control of some human infections much is still to be desired, nevertheless the outlook is encouraging.

Summarizing the essentials given above we have: (1) isolation or quarantine; (2) notification or publicity; (3) disinfection; (4) control of infection carriers; (5) prevention of parasitic infestation; (6) vaccination; (7) pure water supply; (8) clean, nutritious food; (9) healthful housing; (10) scientific research; (11) popular education concerning health matters; (12) organization and co-operation.

The question arises: can such a programme be applied successfully to the prevention and eradication of hog cholera? If so, how can it be done in the most effective and most economical manner? Who shall do the work? And, in the outline given above, where should the greatest emphasis be placed? During the past few years considerable effort and considerable money have been expended by the Federal Department of Agriculture, the Colleges of Agriculture, and the State Boards of Agriculture and Live Stock Sanitary Boards, in laboratory and field experiments on hog cholera control work; all of which will be helpful in the final solution of what to do, and how to do it as well as what not to do. The lack of proper co-ordination and co-operation of the different agencies, due to various causes, has to some extent prevented better results.



Cleaning Up Filthy Hog Pens

It is probable that in some instances each official agency has exaggerated its own importance in the matter and has overlooked, or minimized, the importance of another group that has not been mentioned; namely, the swine raisers themselves, who are more vitally interested in the eradication of hog cholera than the scientific and educational and the veterinary police agencies can possibly be. Some of us who have been working on this difficult problem think we have discovered that the main work of eradicating hog cholera **is the farmers' job**; that is, the practical details of the things that are most essential to prevent or eradicate cholera must be learned and applied **by the swine raisers themselves!** They are the "nurses" who are always on the job. It is important that they should become "trained nurses" who will carry out in a proper manner the sanitary measures that must be applied and which no one else will do for them, nor should do for them, for they are the prime beneficiaries. The efforts of those who regard the eradication of hog cholera as essentially a veterinary problem, to be handled exclusively by a large veterinary police force, and by the extensive application of anti-hog-cholera serum (and "virus") are doomed to failure. Sufficient evidence from practical trials is on record to show that this is true.

The eradication of hog cholera is essentially a "farm management problem," and I for one believe that groups of farmers can soon be taught what is essential for them to do, and can be organized into an effective "sanitary force" that will be able to eradicate hog cholera from any

neighborhood or county in the state. Such a force is not expensive to the state, they are willing to do the work, without salary and traveling expenses, for they are working for themselves and their pay comes in the increased production of swine on their farms and the freedom of their herds from cholera, as well as immunity from the increasing and burdensome tax of vaccination. This "sanitary force," however, must have sound instruction, proper organization and wise leadership. It is manifestly the duty of the Colleges of Agriculture of the various states to organize and carry on, through the departments mentioned, this instructional work, which will teach the farmers what they can and should do for themselves, and how to do it. In developing the outline given above I shall also point out what I consider to be the proper relations of other official and non-official agencies to the work of hog cholera eradication. For no one should be released from his rightful responsibility in this important work.

First of all, I desire to impress upon the farmers the fact that the control and eradication of hog cholera is not dependent upon the large use of anti-hog-cholera serum; and least of all upon the large use of the "serum-virus" or "simultaneous method" of vaccination. The great emphasis that has been put upon vaccination by serum producers, and by a few over-enthusiastic veterinary officials has retarded progress, by diverting the attention of the swine raisers from the more important essentials of hog cholera control. In the words of an official veterinary sanitarian of a neighboring state: "It is high time to quit scattering hog cholera with both hands and both feet and begin to use sense and sanitation." The part I have borne in the development of the production and use of anti-hog-cholera serum, should be sufficient proof that I do not under-value the importance of this valuable agent which indeed I regard as one of the most important discoveries that has been made, so far as veterinary science is concerned. But it is a fact, to be deplored, that its over-exploitation and misuse have led many swine raisers to distrust it. In a right system of hog cholera control it should be placed **secondary** to the more essential things of sanitation. Practical trial on a sufficiently extensive scale in several counties of this state has demonstrated that the principles and methods outlined about (for the control of contagions affecting the human family), can be applied with success to the eradication of hog cholera. I shall now discuss their adaptation to stock-farm conditions and shall try to so simplify the application of the methods that they will not be burdensome nor expensive and will be accepted as a part of a proper system of farm management—so that the "prevention of hog cholera" may, in the main, become an incident to a better system of farming, and not be a cumbersome and expensive system of itself.

ISOLATION AND QUARANTINE

Since the diagnosis of cholera in the early stages is not always easy and positive it is a wise precaution for the swine raisers to separate every sick hog from the herd promptly on the first appearance of any signs of illness. One or two small pigs may have contracted the disease from picking up the infection from the highway that runs alongside the



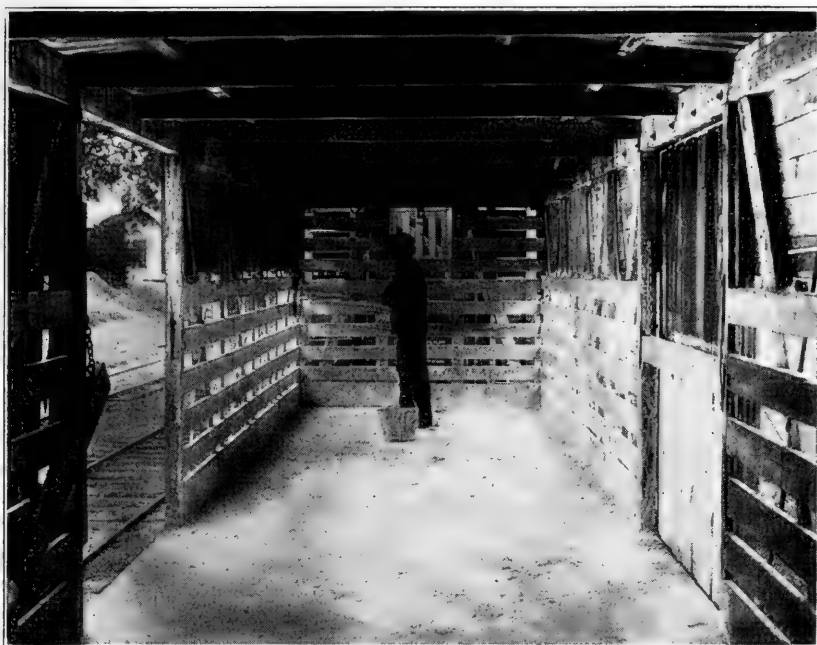
Cleaning Stock Car and Disinfecting with Lime

farm. These smaller shoats are more difficult to keep within bounds than the older hogs, hence are more liable to contract the disease. If they are taken away from the main herd promptly, before they have developed a diarrhoea, the probabilities are that the feed lots will not become infected through their excreta; and the disease may not go further than the first few sick animals. But if they are left with the herd several days, on the supposition that they are probably suffering only from intestinal worms, they have an opportunity to spread cholera infection through the dung and urine to many parts of the feed lots and thus expose a large number of the older hogs. This may result in disastrous losses to the owner and spread the disease to neighboring farms. Hog cholera has been frequently introduced onto a farm by means of imported breeding stock, boars or sows, that have come from infected farms or have become infected en route; or by the "show herd," that has been exposed on the fair circuit. Such animals should never be put with the main herd until all danger of transmitting the disease has passed. They should be put into "temporary quarantine" for three weeks or longer. Such precautions will often save the owner many dollars and prevent the spread of the disease to neighboring farms, as instances I can cite will show. At the price of one or two fat hogs, a good isolation shed and pen can be built, that would serve the excellent purpose of a swine hospital, or quarantine station, for holding and treating sick hogs affected with ordinary troubles; and during a cholera epidemic would be worth thousands of dollars as an aid in controlling the disease.

These isolation or quarantine sheds and pens need not be expensive. The essential requirements are that they shall be located as far as possible away from the breeding and feeding pens; and where the drainage will not flow in the direction of these pens, or toward a neighbor's hog lots. Good dimensions for a cheap and suitable shed are: front 6 ft. high, rear ft., depth 10 or 12 feet—and any length desired. Rough boxing will serve to close the ends and back. The lower half of the front should also be boxed, but the upper half should be left open to admit sunshine, but over the opening, one-inch mesh chicken-wire should be tacked to keep out birds. Rough boxing and tarred roofing paper will make a good water-tight roof of sufficient durability. For the floor, coal cinders tamped to a depth of 8 or 10 inches answers the purpose, especially if protected by laying woven wire over the surface to prevent the hogs from rooting up the cinders. At a slight increase of expense the front half of the floor can be covered with a 4-inch layer of cement for a feeding floor. This can be separated from the sleeping quarters at the back by a 2 by 5 inch scantling set on edge. The cinder floor is better for sleeping quarters than cement. For convenience in handling the hogs the individual pens should not be larger than 10 by 12 feet. Two such pens, under one roof, are usually sufficient for the ordinary farm. If more space is required the shed can be made longer. The open side of the shed should face the south. A strong door with lock and key should be provided to keep out visitors. As a further precaution it is advisable to build a six foot heavy close-mesh woven wire fence (bull fence) around the quarantine shed, with an intervening space of 10 or 12 feet, to prevent the close approach of infection carriers, like hogs or dogs and persons. This outer fence should have a good door, with lock and key. A shallow ditch should be shoveled out on the inside of the enclosure near the fence. This ditch should be partly filled with fresh lime as occasion may demand. These pens will be found useful for other purposes than that of isolating cholera infected pigs. They are also very convenient for holding litters of pigs under treatment for intestinal worms. The great advantage of such pens in isolating cholera infected hogs is that the infected excreta is confined to a small space and can be completely destroyed by the application of a small quantity of quick-lime, or other reliable disinfectant. Moreover, in the case of valuable breeding animals, better nursing can be given in these isolation quarters than if left with herd. The quarantine or isolation measures, recommended and urged, are "voluntary measures," which every farmer should carry out for his own benefit. The neglect of the same may not only cause him serious losses, but so endanger the herds of the neighboring farms, that an official quarantine of the entire farm by the State Veterinary officials may become necessary.

IMPORTANCE OF PUBLICITY

Publicity is a necessary and important aid in the prevention and control of hog cholera. And it is the duty of every swine raiser to prevent the spread of the disease from his own premises in every way he can, if the disease should attack his herd. The owners of adjoining farms should be notified of the danger in order that they may take all the precautions possible against the disease. The simple precaution of removal of a herd to another part of the farm may not only prevent



Stock Car After It Has Been Cleaned and Disinfected

losses in a neighbor's herd, but prevent the formation of a new focus of infection for the further spread of the disease. A neighbor may have a lot of fattening hogs that are almost ready for market and prompt notification of the danger may save the neighbor hundreds of dollars by showing him the advisability of marketing his hogs a few days earlier, or by removing them to safer quarters in the case of his breeding hogs and vaccinating them if that seems advisable. In the past, many farmers neglected this matter of notification of the neighbors, although the law prescribes that it shall be done. The spirit of co-operation that is developing among the farmers to help one another is rapidly correcting this matter.

Notification of the Veterinary Department of the College of Agriculture that hog cholera serum is needed for the control of the outbreak will bring a response from that department with sufficient serum for the purpose, and such instruction and official aid as lie in the province of that department. The new \$50,000 serum laboratory here in Missouri will enable the department to meet promptly every proper demand for serum.

In the event of the infraction of the laws, relating to the disposal of hog cholera carcasses, or when services, requiring the application of official quarantine or veterinary police measures are necessary, the State Veterinarian should be notified; as it is the function and duty of this officer to investigate **and prosecute such infractions!** Or the prosecuting attorney of the county may be notified. Every neighborly effort to correct

illegal and dangerous practices, or negligence, should be exhausted before resorting to drastic measures. Our experience with the plan we have in operation shows that resort to law is rarely necessary.

METHODS OF DISINFECTION

One of the first and most important matters for the farmers to consider in the work of preventing and eradicating hog cholera is that of "disinfection." Precautionary measures in the way of a frequent "clean-up" of the feed lots and hog houses, and a proper disinfection of the same are advisable, and especially at times when cholera is prevalent in the district. The destruction of the seeds of the disease, or virus of hog cholera, is essential to success in eradicating hog cholera. The oldest and most efficient means of destroying disease germs is fire, and it is especially recommended for the destruction of hog cholera infection. The carcasses of hogs that have died from cholera are particularly dangerous as disease producers and should be destroyed by fire. **It is obligatory under the law to burn all hogs that have died of any disease!** The law presumes that they are capable of producing outbreaks of some contagious disease. The old law that permitted the burial of hog carcasses was repealed by the Legislature two years ago. Not only should the carcasses of hogs be burned, but the carcasses of dead animals of all kinds should be burned, since they attract infection carriers like dogs and buzzards that may have fed upon a carcass of a hog that has died of cholera on a distant farm. The destruction by fire of the carcasses of hogs is not difficult it is easier than to bury them. The essential thing is to have a good under-draught which can be secured by scooping out a shallow trench and placing across it a few bars of scrap iron to hold up the carcass; an old mower wheel or a discarded iron harrow frame answers the purpose well. A small amount of wood and kindling put under the hog, and a little kerosene poured over it is all the fuel that is needed. Several longitudinal cuts should be made through the skin and fat, and the belly and chest cavities opened so as to expose the internal organs to the heat, turning the belly down. The fat in the carcass adds fuel to the flame. Fire however cannot be applied under all circumstances as in the case of infected barn yards and feeding pens. Chemical disinfectants, therefore, have an important place. Among these, caustic lime has the highest value for practical purposes in the destruction of hog cholera infection. It is cheap and easily applied and when used freely is very effective. The lime should be purchased in the barrel, in the form of the unslacked burned limestone, and should be used freshly air-slacked. The head of the barrel can be removed and the lime-rock emptied on a dry place under shelter, then sprinkled slightly with water to start the slacking process. When slacked sufficiently to admit of scattering freely with a shovel it is ready for use. Infected feed lots should be disinfected as follows: Pieces of boards, rails, corn stalks, cobs and other rough litter lying around in the infected feed lots should be piled up on the middle of the lot and burned. Then lime should be spread thickly over the ground so that the ground will look as if covered with a light snow. If large feed lots are to be covered, a lime spreader may be used. But a wheelbarrow and shovel answer the purpose well enough even for large



An Ounce of Prevention is Worth a Pound of Cure

feed lots. Keep stock off the ground for a few days, then scrape up the manure into "windrows" by means of a two-horse board scraper (home-made). Scatter more lime on the windrows and shovel the manure and lime into rounded piles, sprinkle more lime over these piles, and let them stand for a few days. The addition of a little water to these piles is advisable if the barnyard manure is dry. This will start the slacking and heating process which will effectually destroy the hog cholera germs. The eggs and embryos of five or six different kinds of worms that commonly infest hogs, and occur in hog dung will also be destroyed by the lime. The manure and lime will help to sweeten and fertilize the soil where you intend to start an alfalfa or clover field. The money spent for lime is not wasted. The cleaned feed-lots should be covered again with another dressing of lime. The hog houses, cots and fences should be white-washed inside and outside with a hot lime-wash. The Compound Cresol Solution made according to the United States Pharmacopeia has been found by laboratory tests at the United States Bureau laboratories to be one of the most efficient chemical disinfectants for destroying hog cholera germs and may be applied in the form of a spray. Mix 1 pint to 3 gallons of water. This is useful in disinfecting wagon boxes and hog houses. Lime, however, seems to be preferred by most farmers, especially for use on the grounds and its reliability has been thoroughly demonstrated both by laboratory and field use. Besides it has an advantage over the cresol, and the ordinary carbolic stock-dips, in being of value to the soil instead of harmful. I may mention that one of the

best swine breeders in the state was able to restock his breeding quarters within sixty days after having had severe losses from cholera. He used nothing but fresh air-slacked lime, but he did a thorough job. An experiment was made by the Veterinary Department of the Experiment Station in the disinfection of an infected pen, in one of the local railroad stock yards; (pen in which a number of hogs had died from cholera) this pen was treated to an application of fresh air-slacked lime. In a few days six pigs were turned into the pen and fed there for three weeks. They did not receive any medical treatment nor special care and no symptoms of illness had developed at the end of the period. These same pigs were put in a clean pen for a few weeks at the State Farm for further observations; none showed any signs of cholera. Then, as a test of their susceptibility, they were exposed to infected pens at the serum plant. They promptly took the disease and nearly all died. This experiment demonstrated that quick-lime or freshly air-slacked lime is an efficient agent in disinfecting badly contaminated hog lots in the stock yards.

The ordinary carbolic dips and disinfectants are not as efficient in destroying hog cholera infection as the Compound Cresol Solution, according to tests made by the United States Bureau of Animal Industry.

The thorough disinfection of large fields, pastures, and woodlands by means of chemical disinfectants such as lime and Compound Cresol Solution, is of course impracticable, yet such fields can be made safe for susceptible hogs. If hogs are kept out of infected fields for a sufficient time, the germs of the disease die out. The germs do not seem to have the power of growing outside of the body of the hog. Although the life of the germs may be conserved for awhile outside of the body if conditions are favorable. It has been observed that the hog cholera infection dies out more quickly in open fields well exposed to the rays of the sun than in moist, shaded places. The cholera germs on exposed grounds are killed quicker during the summer months than in winter. Strong sunlight is a good disinfecting agent for a number of disease germs and among them hog cholera. It is advisable to put cattle, horses or sheep on the cholera infected pastures and let them crop the grass closely, so as to give the grounds a good exposure to the hot rays of the summer sun. Hogs are not so liable to contract cholera in the large fields as in the smaller feed lots, since the infection would not be so concentrated, so far as the droppings from sick hogs are concerned. The most thorough disinfection of the large fields and pastures can be assured by making a search for carcasses of pigs and for the bedding places that sick hogs have used. Fire and a little lime can be used to advantage in destroying the cholera germs in these.

The time required for the cholera infection to die out on large fields and pastures will vary with the conditions of weather and soil and exposure to sun, as well as the degree of infection. Under the most favorable conditions large fields that have become infected will probably not be entirely safe for susceptible hogs under 90 to 100 days, though cases are reported where infected fields were apparently free from the infection in less time.

Every possible effort should be made to prevent large fields and pastures from becoming infected with cholera germs.



The Local Stock Yards—A Source of Infection

THE CONTROL OF INFECTION CARRIERS

The most dangerous infection carriers with which the farmer has to deal are the sick and exposed hogs. The driving of sick hogs upon the highways to market **is prohibited by law**; but the law is sometimes broken by those who are ignorant of the provisions, and sometimes by those who know the requirements of the law, but ignore them and have no regard for the rights of their neighbors. Sick hogs should never be removed from the farm, but should be closely quarantined until they have recovered, or have died. And the infection and infected carcasses should be destroyed. This shipment of sick hogs to market, even when hauled to the shipping station, spreads the disease and increases the dangers at the local and large central stock yards as well as being a source of danger to the farms lying along the railroad lines.

Healthy hogs that have been exposed to sick hogs in the same feeding pens may transmit the disease from contamination of their feet and bodies and should not be driven over the roadways to market. They should always be hauled to the shipping station. If driven to market the farms along the highway are endangered. Streams crossing the highway and passing through one or more farms may become sufficiently contaminated from the feet and bodies of the hogs to start an outbreak. Only healthy hogs from clean farms, should be driven to market; and it is probably a good practice to haul these, on account of the shrinking in weight from driving.

Cattle that have been fed in feed lots where hogs have been dying from cholera may also carry the infection on their feet when driven to market and spread it along the highway, from whence it may find its way to adjacent farms. The feet of cattle may be easily disinfected by driving the animals through the dehorning chute, in the floor of which every farmer should have a shallow vat, preferably of concrete. The vat should be the full width of the chute and 8 or 10 inches deep. This vat is serviceable in the treatment of sore feet in all farm animals, particularly cattle and sheep. A strong solution of copper sulphate (blue stone), or a 5 per cent solution of the Compound Cresol Solution should be used to clean and disinfect the feet of cattle that have been on cholera infected grounds.

The danger of a recently purchased lot of feeding cattle carrying the disease from an infected stock yard to the farm should not be overlooked and proper precautions should be taken to disinfect the animals' feet before hogs are exposed to them.

Dogs: It is well known that dogs serve as carriers of cholera infection. It is therefore advisable, during outbreaks of cholera in the neighborhood, to keep all valuable dogs in quarantine, especially at night to prevent them roving about and visiting cholera infected farms where carcasses may have been left unburned. Worthless stray dogs should be destroyed.

Barnyard Fowls: The infection is easily carried by chickens and turkeys from the roadway along which diseased hogs have been driven, or from an infected pen to clean pens, on other parts of the same farm. These fowls should be shut away from the hog lots during outbreaks of hog cholera on the farm, or in the neighborhood. A few dollars spent in poultry netting will be less expensive than buying serum; and will often save hundreds or thousands of dollars to the neighborhood. Pigeons are more dangerous as infection carriers because of their habits of flying to neighboring farms and feeding with hogs that may be suffering from hog cholera. The pigeons should be destroyed or should be kept in confinement when cholera is in the neighborhood. Buzzards and crows should be dealt with by shot-gun quarantine. "Simultaneous" and repeated attacks upon the roosting camps of these undesirable birds, by "Farmers' Clubs" or "Anti-hog-cholera Clubs" will soon rid a neighborhood or county of these infection carriers.

Undesirable Persons: The traveling hog-doctor, with his "sure cure" and "preventive" for hog cholera, and all other ills to which swine are subject, should not be a welcome visitor—for he is liable to be an infection carrier. His business takes him to diseased herds; and as a rule these business parasites are not careful to thoroughly disinfect their contaminated shoes and overalls after treating (?) a diseased herd. The itinerant "vaccinators," and the local "farmer-agents" for serum companies are also undesirable visitors; they are more interested in the "commissions" and "fees" than in sanitation; and more likely to spread cholera virus on your farm "with both hands and both feet," than they are to give relief from a threatened danger from other sources. The local stock buyer is a valuable go-between for the farmer in marketing



Prowling Dogs Spread Cholera Far and Wide

small lots of hogs; but he becomes a nuisance and menace if he forms the bad habit of seeking for bargains in diseased and badly exposed herds. He thus aids in maintaining infected pens at the local stockyards and carries infection on his shoes to healthy herds and clean farms. The owners of healthy herds should keep stock buyers out of their hog lots if they have come from infected premises and have not properly disinfected their shoes. Stock buyers should join the farmers' "Anti-hog-cholera clubs" and do everything they can to aid in eradicating cholera by applying proper sanitary measures. It will serve their own business interests in the best possible manner.

Teams and wagons: Cholera infection may be carried to healthy herds and farms by teams and wagons. Threshing outfits that go from farm to farm should be careful to not drive through cholera infected hog lots, or in fact through healthy hog lots. Inquiry should be made as to the presence of cholera on the farms where threshing is done. And every precaution should be taken by every man on the force to avoid coming in contact with the infection and to prevent the teams and wagons from doing so. When hogs are hauled to the local stock yards it is a wise precaution for the farmer not only to disinfect his shoes but also to disinfect the feet of the team and the wheels of the wagons before returning to the farm. Especially if sick hogs have recently been unloaded in the local stock yards. Also disinfect the inside of the wagon box, and the litter it may contain. (See "Chemical Disinfectants"—under Disinfection).

Streams: Hog cholera infection may be carried from one farm to another by the water courses that run through them. It is not the fault

of these streams if they become polluted and carry disease, but the fault of the farmers through whose farms the streams run. For by co-operation and by observing the precautions given above it will be rare for a stream to become polluted. We cannot change the general course of the streams nor stop them from flowing; but we can protect them from pollution with hog cholera infection. Sick hogs must not have access to the streams; dead hogs must not be permitted to rot in them; and cholera infected litter and manure must not be allowed to wash into them; these things we can control. But when danger from such a source does occur, losses can be avoided by removing the healthy herds to other fields away from the infected stream. Or the stream can be fenced off from the field occupied by the hogs.

In our county organization plan (see "Organization and co-operation") every member of an "Anti-hog-cholera club" regards it as a special duty to notify the owners of farms whose herds may be endangered by the drainage from his infected farm and this practice is recommended to farmers in counties not yet organized.

Ponds: On farms where the stock water is supplied from ponds, these ponds may become sources of danger, if not protected from pollution. The pond should be fenced in so as to prevent the hogs from wallowing in it. One sick pig may endanger the whole herd by infecting the pond. Dogs should also be fenced out—for roving dogs have a fondness for stock ponds, as well as for cholera carcasses and may infect the pond. The fence should be made of woven wire of proper height and the top should be guarded by a couple of barbed wires. Watering troughs, set at a level lower than the pond, and at any distance desired, can be kept full of water by means of water pipes and automatic "cut-off."

It is also a wise precaution to protect the drainage area above the pond by fencing out the farm stock, particularly the hogs, since the drainage will carry some of the droppings into the pond. These droppings, even if free from hog cholera germs, often contain great numbers of intestinal worms and their eggs. The drainage area should be put in meadow grasses for hay crops.

Stock Cars: Stock cars that have transported diseased hogs may carry hog cholera infection long distances if the litter and cars are not properly disinfected. The recent experience of a number of states with foot-and-mouth disease calls attention strongly to the danger of spreading disease by means of stock-cars.

Provision has been made by the Federal Bureau of Animal Industry for disinfecting cars that have carried hogs to the large markets for slaughter, whenever an interstate shipment is found to contain sick hogs. And a number of states have regulations requiring a "health certificate," and proper disinfection of the cars, for hogs shipped into the state. Adequate provisions, however, have not been made in many states at least, for the disinfection of cars that have carried hogs from one locality to a distant part of the same state. This is a matter that is left largely to the discretion of the shipper and consignee. And the neglect to disinfect the car at the starting point before loading the hogs, and again at the destination after unloading has, at times, resulted in the spread of



Poland China Sow

cholera. The transportation of infected hogs across the state can scarcely be accomplished without the dropping of infected litter along the right-of-way and at the terminal station. Many outbreaks of cholera, which have spread widely over a neighborhood have originated from the shipment of feeding hogs from a distant part of the state, or from an adjoining state. Even shipments of supposedly immune hogs (serum-virus treated) have carried cholera long distances; in one instance, from Missouri to Indiana.

Shippers, consignees, and railroad agents should co-operate to lessen the dangers of spreading cholera through infected hogs and stock cars, even if no official regulations governing the matter are in force. For the business interests of all three will be promoted by getting rid of cholera.

Simple, practical measures of prevention can be applied that will obviate, to a large extent, the dangers mentioned, if the shipper, railroad man and consignee will co-operate; (1) to prevent the shipment of hogs, for feeding purposes from infected yards and farms; (2) to see that they are not collected in infected shipping pens; (3) nor shipped in cars that have not been properly disinfected; (4) and not unloaded enroute in infected feeding pens; (5) nor in an infected pen at the terminal station. And all this can be done without much expense. The money saved through the prevention of cholera will meet the expense many times over. The disinfection of a stock car is not an expensive nor difficult task. Caustic lime (freshly slacked) and Compound Cresol Solution are cheap and efficient disinfectants and are easily applied.

If lime is used it should be sprinkled freely over the floor of the car before the removal of any manure or bedding. Water should then be sprinkled over the lime and litter and the whole scraped up and removed

from the car. This manure and litter should be dumped in some protected place where hogs cannot come in contact with it; and where it can lie a few days to heat, after a further application of lime. After the car has been made tolerably clean with shovel and broom, more lime should be scattered over the floor and moistened by means of a spray pump or sprinkling can. And the walls of the car should be sprayed or mopped with a hot lime-wash made by adding unslacked lump lime to a bucket or tub of water. A handful of salt dissolved in each bucket of water before adding the quick lime increases the efficiency of the solution. A car thus cleaned and disinfected will carry hogs from one part of the state to another without danger of infecting them with cholera. The car should be properly bedded with clean straw. Ordinarily a bushel to a bushel and a half of quick lime will be sufficient to disinfect a 36-foot stock car with floor space of 300 sq. ft. And the cost of the lime will not exceed 50 or 60 cents. And even if it should require a full barrel, its use would be a wise precaution, as insurance against the loss from cholera of a good part of the shipment and against spreading the disease to other herds.

If the Cresol Compound (*Liquor Cresolis Compositus*) (U. S. P. formula) is used it should be diluted with water to make a three or four per cent solution. One gallon of the undiluted solution will make up 33 gallons of a 3 per cent solution or 25 gallons of a 4 per cent solution. Sprinkle or spray the litter and dung thoroughly with the disinfectant before scraping it up and removing from the car. Then spray and scrub the floor and wash down the walls of the car with the same solution.

For the disinfection of stock cars used for interstate shipments of swine the regulations of the United States Bureau of Animal Industry specify the use of "4 ounces of Cresol Compound U. S. P. to each gallon of water." That is a 3 per cent solution. They also advise the addition of 1½ pounds of lime to each gallon of the diluted solution to show where the solution has been applied. (See Amended order 210, effective Feb. 10, 1915). The Government regulations referred to do not require that the litter and manure shall be disinfected before removal from the car. This may not be so important at the large market centers and especially where there are "reducing plants" for incinerating the litter and dung from the cars and stock yards. But at shipping stations in the rural districts the litter and manure should always be well mixed with a good disinfectant before removal from the car. Such a precaution will aid in keeping cholera away from the farms in the neighborhood.

As already mentioned, carbolic acid and most of the coal-tar stock dips are less efficient for the purpose of destroying hog cholera infection than the Cresol Compound Solution. The market price of the undiluted liquid is about \$1.25 per gallon.

The Local Stock Yards: It is a matter of much importance in the control and eradication of hog cholera to maintain sanitary shipping yards in the farming districts. And this is not an impossible task, nor expensive if the work is properly apportioned. An attempt is being made to solve this problem in the counties that have organized Anti-hog-cholera clubs. Proper care of the healthy and sick herds on the farms, by



Duroc Jersey Boar

methods already recommended will lessen the opportunities to carry infection to the shipping station. The shipments of sick and dead hogs is illegal, in some states, and should be made so in all states. It would work a great hardship, however, if swine raisers and feeders were not permitted to ship healthy "exposed" hogs that have not developed symptoms of the disease. But such hogs should be hauled to the station in tight-bottom wagon boxes, and should occupy a special pen at the stock yards while awaiting shipment. And a separate chute for loading should be provided. A slight re-adjustment of existing stock pens can be made at small cost that will meet the requirements. The spraying of hogs with bad smelling chemical disinfectants when these hogs are destined for immediate slaughter is objectionable. It is therefore all the more desirable that exposed hogs, though healthy, should be provided with a separate pen; since the hair, skin, and feet of these hogs may carry infection, from the cholera infected farm, to the local stock yards. It also happens that in separating the apparently healthy hogs from an infected herd for shipment to market, a few hogs that are not visibly sick may develop symptoms of illness before they are loaded on the car. The excitement and fatigue of the infected animal, caused by the handling and hauling from the farm to the shipping station often hastens the development of the cholera symptoms and a hog that was thought to be healthy when it was hauled from the farm may prove to be affected with cholera. These acute cases of cholera are liable to badly infect the local yards, if the affected hogs have access to the general pens and alleys; while if put in the special pen for "cholera exposed" hogs, the danger of spreading the disease to other farms would be greatly lessened. Farmers from other neighborhoods would not run so great a risk of carrying the cholera in-

fection back to their farms, by contamination of their shoes with mud and dung from cholera infected pens. The cholera virus would be confined to a smaller space where it could be destroyed at less expense and labor. A cement floor in this pen is desirable to facilitate the cleaning and disinfection. And it will pay any farming community to put it in. Two or three good sized fat hogs will pay the cost. In fact it will pay any farmers' club, or "Anti-hog-cholera club" of 25 or 50 members, who use the same shipping pens, to put concrete floors in all the pens at their own expense, even if the railroads would not bear a portion of the cost. The loss from cholera to individual farmers have in many instances exceeded the cost. And infected shipping yards have often been the source of the trouble.

The railroad industrial agents of a number of roads have shown an active interest in the hog cholera eradication work as outlined herein. And in Knox County, where through the University Agricultural Extension Department, and the County Farm Bureau of this county, a series of meetings was recently held and sixteen Anti-hog-cholera clubs organized, the Superintendent of traffic of the Santa Fe Railroad issued instructions to the local agents to co-operate with the University and the Farm Bureau, and to keep on hand a sufficient quantity of quick lime for the purpose of maintaining sanitary stock pens. The farmers and shippers belonging to the Anti-hog-cholera clubs, co-operating with the County Farm Adviser, will attend to the disinfection at sufficiently frequent intervals. In Johnson, Dade, Bates and Cass counties where a large number of farmers have also organized "Anti-hog-cholera clubs," the local agents of the railroads have shown a ready willingness to co-operate with the clubs and to do all they can to help keep the local stock yards free from hog cholera infection.

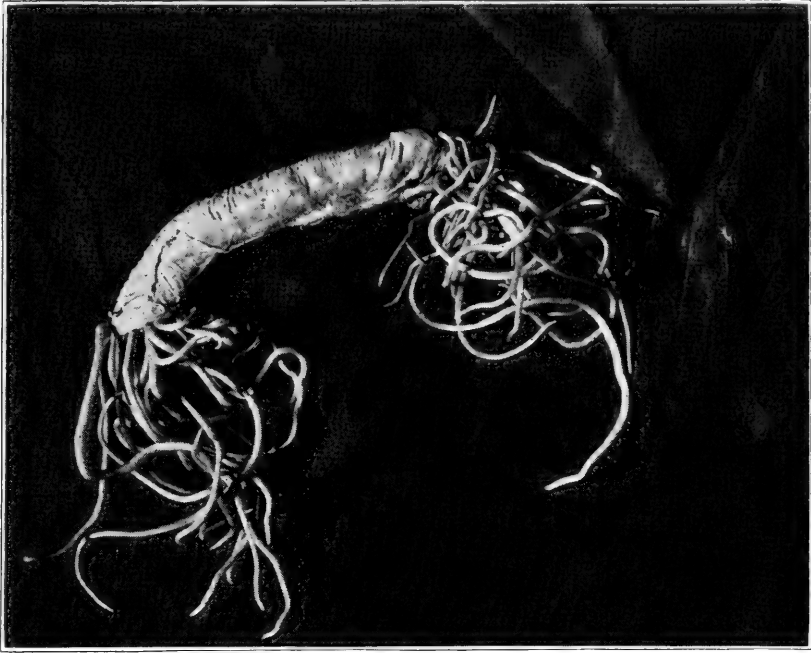
PARASITES OF SWINE

It is a matter of common observation that herds of hogs that are badly infested with worms and lice are less resistant to cholera than herds that are kept free from such parasites. The percentage of loss from cholera is greater in wormy herds, and the serum treatment is less effective. And when such herds are vaccinated by the serum-virus method, a larger per cent of the animals contract cholera in a fatal form, than in herds that are practically free from worms.

Worms when present in considerable numbers, in the stomach, intestines or lungs produce an irritation of the mucous membranes which frequently results in local congestions or inflammations that are favorable to the passage of the hog cholera germs into the blood.

There are a dozen different kinds of worms that infest hogs. But the ones most often found, and that cause irritation and inflammatory conditions that increase the susceptibility of hogs to cholera are the following: (1) Common round worm (*Ascaris suis*); (2) Thorn-headed worm (*Echinorhynchus gigas*); (3) Lung worm (*Strongylus paradoxus*); (4) Kidney worm (*Stephanurus dentatus*).

The first named worm, the common round worm, when full grown, is from 6 to 7 inches long and about 3-16 of an inch thick. But smaller



Pig's Intestine Clogged with Worms

specimens, of different sizes, are often found in large numbers in the same hogs. These worms are most frequently found in the small intestines, but occasionally a few crawl into the stomach, and even into the oesophagus and out of the mouth, causing violent coughing from tickling the throat. A few of these worms when quite small may also pass from the small intestine up the gall-duct and into the liver. They sometimes completely obstruct the gall-duct and prevent the bile from passing out into the small intestine, thus producing a very yellow or jaundiced condition of the skin and fat of the affected hog. This yellowness of the skin is so noticeable in white skinned hogs, that the presence of these worms in the gall-duct and liver can often be predicted before cutting into the carcass. These worms are sometimes so numerous in pigs as to cause severe digestive troubles, and even obstruction of the bowels. I recall finding over fifty worms in a 35-pound pig; and a mass of worms had obstructed the bowel at one point.

The "thorn-headed" worm, about the same size as the common round worm, also infests the small intestine; but it fastens itself to the wall of the gut, where it remains until fully matured. The head of this worm is provided with barbs or hooks pointed backward, so that when the head is thrust into the wall of the gut, the worm cannot be detached without considerable force. The irritation caused by the rough barbed head of this worm produces a small fibrous tumor, which is quite noticeable on the outer surface of the small intestine, as a white, raised lump, from a fourth to a half inch in diameter. The head of the worm is imbedded in these tumors. Sometimes a dozen of these worms will be found attached

to the wall of the small intestine. Hogs thus infested are less resistant to cholera, because of the irritated bowels. When cholera attacks hogs with worm-infested bowels the signs of the disease are often found in this location, in the form of haemorrhages or an acute inflammation of the mucous membrane—or in the chronic form of ulcerations. It is therefore a wise precaution to prevent hogs from becoming infested with intestinal parasites.

The next worm mentioned is the "lung worm" (*Strongylus paradoxus*). This is a small thread-like worm an inch to an inch and a half in length and is usually found in clumps of a half dozen or more in the smaller bronchial tubes, in portions of the lungs that show evidences of inflammation. On cutting through the inflamed or solid portion of lung so as to cut across the small air tubes, masses of the worms are sometimes exposed, protruding from the small bronchi. A better way is to cut along the trachea by means of a heavy pair of scissors, and follow the air tubes down into the inflamed area. Masses of mucous and worms will be easily found, if a serious infestation exists. This lung infestation is sometimes found in apparently healthy hogs that are butchered—the animal having shown no loss of appetite nor evidences of illness, except possibly an occasional slight cough. Yet when the animal is slaughtered the lungs may show small areas of solidification as large as a hen's egg or larger. And the worms mentioned may be found in these small localized areas of broncho-pneumonia. Should herds thus infested with lung-worms be exposed to cholera, or be vaccinated by the serum-virus method for protection against cholera, the already irritated lung would supply a favorable condition for the development of acute cholera with serious pneumonic complications. Hence the importance of keeping the hogs free from these lung parasites.

The "kidney worm" (*Stephanurus dentatus*) has never been accused of carrying cholera; but when we consider that this is a worm that bores through the tissues of the hog and finds its way to various parts of the body, the kidney fat and sometimes into the kidney and liver, producing abscesses in these organs, it is not at all improbable that in the migrating stage of this parasitic worm it produces minute lacerations and inflammations in the intestinal walls, which are favorable to the passage of hog cholera germs into the blood. At any rate the presence of these parasites in the tissues of the hog cannot help but lower the vitality of the animal, and every precaution should be taken to prevent the pigs from becoming infested with these worms.

There are other worms that infest hogs that are not regarded as dangerous to the health of the animal, unless present in excessive numbers. There are four and possibly five kinds of small parasitic worms that infest the stomach. Some of these lie free on the mucous surface—and probably subsist on the food contents without irritating the walls of the stomach. One, however, forms small cysts in the walls of the stomach; and another is a blood sucker (*Strongylus rubidus*) which causes severe inflammation of the stomach walls. Fortunately this latter parasite is rare in America, and on that account has but little significance for us so far as cholera is concerned.

There are also three or four small parasitic worms that infest the



Worms from a 45-pound Pig. Portion of Small Intestine at Center

intestines, but which do not appear to cause any serious irritation of the intestinal walls. Of these I will mention the whip worm (*Trichocophalus crenatus*) found in the large intestine and caecum. This worm is from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long. But the greater part of its body is so slender that the worm is easily overlooked, when the mucous surface is examined. The head portion resembles the lash of a whip, while the posterior portion, short and thick (containing the ova) represents the handle of the whip. The head of these worms is imbedded in the mucous coat of the caecum or large intestine. And the possibility exists that they may, if present in large numbers, cause sufficient irritation to produce favorable points of entry for the hog cholera infection into the blood. It is in this region that haemorrhages and chronic ulcerations often occur in cholera.

Sometimes pin worms (small white worms $\frac{1}{2}$ inch long) occur in considerable numbers in the large intestine.

Trichina and tape worm cysts are so rare that their possible relation to hog cholera, as contributory causes, scarcely needs mention.

Prevention: No one believes that any of the worm parasites mentioned are in any way beneficial to the hog. And their destruction is to be desired. This can be accomplished easiest by good sanitary farm management. It is better to keep the worms out of the hogs than to try to kill and expel the worm after the hogs are badly infested. The latter task is sometimes a difficult one. Nearly all these parasites pass a part of their existence outside of the animal body, in the barn-yard manure and litter. And if these barn yards are given proper attention most of the worms and their eggs can be destroyed, so that the pigs will not become badly infested. The same disinfection that was recommended to destroy the germs of hog cholera, on the hog lots, will also destroy the worms, eggs and embryos of all these parasitic worms, when they have escaped from the body of the hog. The free use of fresh lime on the hog yards is the best worm medicine known, the hog does not have to

take the dose; the worms and the eggs and embryos get it instead. The water supply should also be protected to prevent hog dung, worms, and worm eggs from washing into the ponds.

Worm remedies: Prevention of worm infestation is more desirable than treatment; and the measures recommended for hog lot sanitation will be a great aid. But occasionally internal medication will be necessary. The following remedies and measures are recommended.

(1) A mixture of equal parts of salt, sulphur or hyposulphite of soda, Glaubers' salts and copperas (iron sulphate) and a double portion of wood charcoal is a good laxative tonic, which also has vermicide properties. It is helpful in destroying the eggs and embryo worms in the stomach and intestines in the early stages of infestation. The mixture is relished by hogs and it can be kept in a trough under shelter where the hogs can partake of it at will. The ingredients should be thoroughly pulverized and well mixed.

Experiments made at this Experiment Station showed that "blue stone" (copper sulphate) was more efficacious in destroying the thorn-headed worms than other drugs that were used. It can be substituted for the "copperas" in the above mixture, using half the quantity.

(2) **Turpentine** is useful as a vermicide. It can be given in tablespoonful doses to a hundred pound shoat. It should be fed in greasy slop or milk.

Turpentine is absorbed to some extent, and eliminated in part through the lungs, as well as the kidneys. It stimulates the mucous secretion of the bronchial tubes and aids in the expulsion of the "lung worms."

(3) **Santonin** is one of the most efficient worm remedies but is somewhat expensive. It can be given to hogs in doses of four to six grains, to the 100 pounds of live weight. It is usually combined with calomel and bicarbonate of soda; santonin 6 grains, calomel 4 grains, bicarbonate of soda, 1 drachm. By adding powdered areca nut, in 1 drachm doses, the quantity of santonin and calomel can be reduced a half.

When giving this combination the pigs should not have access to the first mixture containing salt—since calomel and salt may combine and form corrosive sublimate, which is very irritant and liable to salivate the pigs, and ulcerate their bowels.

Before giving the worm medicine, the pigs should be grouped into bunches of ten to a dozen, according to size, so that the smaller pigs will not be robbed by the larger ones of their proper portion of the medicated food. The pigs should have no food except water for twelve to eighteen hours, so as to empty the bowels.

The quantity of the medicine necessary for each lot of ten or twelve pigs can be calculated with sufficient accuracy, from a rough estimate of their combined weight, the medicine should be stirred into a thick slop made of shorts and water. In order to insure its more even distribution through the slop the dry powders should first be thoroughly mixed with a handful or two of dry meal and this can be sprinkled into the slop while it is being stirred. After feeding the slop, keep the pigs in the quarantine pen for twelve hours, or longer, so that the expelled worms will not be scattered over the hog lots. Some of the expelled worms will



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not be killed and may contain numerous fertile eggs. Scatter air-slacked lime over the floor of the quarantine pen to destroy the expelled worms and their eggs.

It is a good practice where coal is burned, to keep in the corner of the hog lots a pile of coal cinders. The bits of unburned coal and the iron and other salts contained in the ashes, are better worm remedies than many of the "hog powders" which the farmers pay out money for. If a half bushel or more of crushed lime rock is added occasionally to the cinder pile it will be helpful in strengthening the bone of the pigs and brood sows that eat of it. No coaxing is required to get the hogs to attack the cinder pile. But a little salt and shelled corn thrown upon it makes it more attractive.

LICE AND HOG CHOLERA

In combatting hog cholera, the herd that is kept free from lice, is less liable to contract the disease than a herd that is badly infested with these irritant blood suckers. The resistance of lousy pigs is greatly weakened and the losses from cholera in such herds is usually quite heavy. The following measures of prevention and treatment are recommended:

Kerosene Emulsion is very effective in destroying lice. It is made as follows: Dissolve a half pound of hard soap in a gallon of hot water. The soap is dissolved more quickly by cutting it into thin slices. When the soap is completely dissolved, add two gallons of kerosene. The kerosene is added little by little and the mixture is stirred vigorously until a permanent creamy emulsion is formed. The mixing is made easier by churning up the fluid, by means of a hand spray pump. The emulsion

thus made can be kept for a considerable time by pouring it into jugs and corking tightly. For use in killing lice on hogs this emulsion is diluted with 15 to 20 volumes of water. It is stirred or churned into the water so as to make a uniform mixture. The diluted emulsion is applied to the hogs by means of a sprinkling can, or a spray pump. The hogs that are to be treated should be put in a pen that is small enough to crowd them well together so that the rubbing of the animals against one another will insure a thorough smearing of the emulsion into the hair of every hog. The bedding places should be thoroughly sprinkled or sprayed with the emulsion. It is a good practice to clean out and burn the hog bedding frequently.

Crude petroleum oils: the lighter oils are now finding favor with many swine breeders and feeders. It is a cheap and effective means of destroying lice—and can be applied in the same manner as the Kerosene Emulsion. The heavier oils are objectionable because they “gum up” the hair. When sprinkled over the hog beds, the crude oil not only kills the lice but it keeps down the dust and prevents bronchial irritation and the resulting cough and makes the hogs less liable to contract cholera.

Dipping tanks may also be utilized by filling them to a proper depth with water and adding a layer of oil 3 or 4 inches deep. Where concrete hog wallows are in use, it is advisable to pour in a little oil occasionally.

The grade of oil recommended will cost from \$3.50 to \$4 for a 50-gallon barrel, and probably less when several barrels are purchased by farmers' clubs.

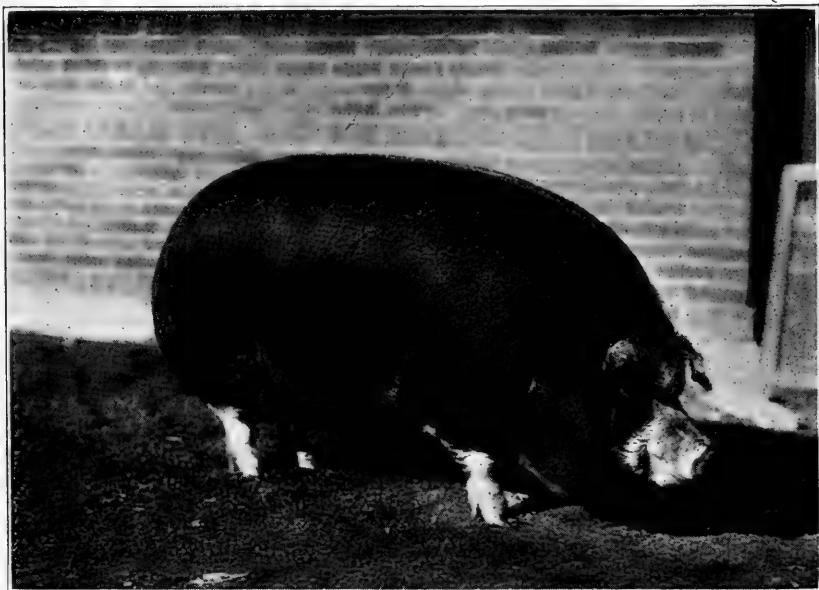
FOOD AND WATER

For the maintenance of health in all animals the food and water supply should be of good quality and free from contamination with disease producing organisms.

The water supply was discussed to some extent under the section “streams” and “ponds” as disease carriers. Surface water if kept free from pollution is not objectionable, in fact often preferable to the deep-well water of certain sections. But the deep-well water is not so liable to become polluted with cholera germs, and if free from objectionable mineral substances, as salt, sulphur and excess of lime, is much to be preferred on account of the smaller danger of carrying cholera infection.

The food supply is rarely a carrier of cholera infection. But corn that is hauled in a wagon box, that was used a short time previously to haul “sick and exposed” hogs to the shipping station, will certainly become contaminated with hog cholera virus, and give the disease to hogs that eat of it, unless the wagon box has been properly disinfected. Waste food in corn fields that have been partially hogged down may be contaminated with hog cholera virus if some of the hogs that were first turned on the fields were infected with the disease. Other hogs turned into the fields later may contract cholera, if not previously vaccinated. Sick hogs should not be allowed to run in the fields where corn has been cut and shocked—as their feeding and bedding about the corn shocks is liable to infect the corn and fodder and transmit the disease to other hogs.

The question is often asked: “Is “tankage” ever a carrier of hog



Poland China Sow

cholera infection—since, many cholera infected hogs are “tanked” at the packing houses. There is but little danger of transmitting cholera by feeding tankage. The tankage is subjected to a high degree of heat and germs of all kinds are destroyed. And if it is subsequently handled in a manner to prevent it from becoming contaminated with the germs of hog cholera there is no danger in feeding it. Special care should be taken by the men who sack and handle the tankage to avoid carrying cholera infection into the tankage storage room of the packing houses. The men assigned to this particular work should not handle cholera carcasses, they should not go from a cholera infected pen into the storage room without first changing their shoes. Proper precautions in these respects will prevent the tankage from becoming infected, after it comes from the tanks.

Quality of the food: Hogs are sometimes fed on immature, moulded or worm-eaten corn that is rejected as food for horses and cattle. But hogs so fed will not thrive as well as when fed on corn of good quality. Such food is liable to contain, or form, poisonous products that cause irritation of the digestive tract and disturbance to digestion. Diarrhoea may result. The poor quality of the food is thus liable to render the hogs less resistant to cholera, if they should become exposed to the virus of that disease. This also applies to the feeding of new corn, if fed in excess. The starch in new corn is not fully ripened and is softer and more fermentable than in old corn, that is well cured and hardened; hence it is more liable to cause digestive disturbances and a lessened resistance to cholera. New corn never creates cholera but it can easily produce conditions in the hog that render the animal more susceptible to the disease when exposed

to it. Care should be taken to not crowd the new corn too rapidly to a full feed; but to mix with it old corn and proper protein supplements.

Balanced Rations: Hogs are fed for profit and the farmer desires to get the greatest profit possible out of the feed that goes into the hog. That is, he desires that as much of the food as is utilizable shall be converted into permanent tissue, flesh, fat and bone; and that none, or but little, of the nutritious elements of the food shall pass through and be lost with the indigestible waste products, or lost in other ways. But in the matter of feeding, the best results cannot be attained without some knowledge of the "science of feeding." Many farmers have studied these matters and are profiting by them. And it is true that many farmers know how to put a large number of pounds on their hogs in a short period of time, without knowing anything about "balanced rations," and by following a fixed plan of their own. But in the case of these, it frequently happens that in getting their good gains in a short time, they have not done it in the most economical way; and have lost some of the profits that could have been saved. It is well, therefore, for every feeder to study the matter of "balanced rations"; for this is the key to profitable feeding. It is not my purpose, however, to go into the details of this subject, and to give specific formulae for rations, of the various mixtures of food stuffs that should be fed to the breeding herd, the growing shoats, and the fattening hogs. That phase of the work belongs to the Animal Nutrition Department. But it is proper to mention in this connection that the natural resistance to cholera is greatest in an animal whose physiological functions are kept at their best, and proper feeding is one of the essentials. Some mention of the principles of feeding is therefore pertinent, and this I shall present in the simplest and most elementary way.

The food stuffs upon which the animal subsists must necessarily, as a whole, contain the same chemical substances found in the animal body. The animal body requires three kinds of food substances: (1) Protein (or nitrogenous materials) for the building up of the muscles and other active tissues. (2) Energy and heat producing foods, as fats, occurring in the oils; and carbohydrates, in the starches and sugars. (3) Inorganic foods (water and mineral salts). The animal body simply appropriates as much of the available chemical substances in the foods as it, for the time being, needs, or is able to store up for future use. The excess of these chemical substances in the food eaten is eliminated from the body. And it not infrequently happens that this excess of food material that can not be used by the animal and is eliminated as so much waste material, are in fact high priced food elements which the feeder is losing because he does not understand the physiological needs of the animal. To illustrate this matter roughly: Let us suppose that a lot of fattening hogs, on full feed, were left for a week in charge of a simple minded conscientious lad who knew nothing about feeding, but was told the quantity of corn to give but misunderstood the instructions and gave them daily, twice as much as they could possibly eat. The result is easily seen; a gross waste of corn, trampled and soiled in the mud and manure of the feed lot. But the same thing happens in a less degree, and in a different way, when hogs are fed on an unbalanced ration all the feed they will clean up. The feeder thinks that because the pigs eat up all the food



Berkshire Sow

given, and they are taking on weight, the ration given meets the proper needs of the animals—while in fact they may be wasting considerable food for the owner, and wasting some of their own energy in the labor of eating, digesting, absorbing, and trying to transform into body substance an excess of one class of food material in securing enough of another class, and expending further energy in eliminating from the body the excess of this good but unusable food material. This physiological mistreatment of the hogs is not good for the owner's pocket-book, nor is it good for the health of the hogs. Certain organs of the body are overworked and the animal becomes less resistant to cholera. An example of this is sometimes seen in hogs that are fed exclusively on corn—a highly carbonaceous, starchy food, a fat and heat producer. Corn contains some nitrogenous, or proteid substances, but not in sufficient quantity to properly balance the ration. Hence a greater quantity must be eaten in order to supply the proper quantity of protein. And the result seems to be that the vital tissues are lacking in tone and resistance because of unbalanced nutrition. The tissues are over-fat and flabby, and the death loss in such herds is usually large when infected with cholera.

If a proper amount of protein is added to the ration, in the form of tankage or oil meal, soy beans, alfalfa, etc., less corn will be required, the expense of fattening will be less, and the animals will be more healthy and vigorous.

HEALTHFUL HOUSING

The common ailments that are caused by weather changes, and undue exposure to cold and wet, are just as liable to occur in hogs as in other animals. They contract "colds," influenza, sore throat, bronchitis and

diarrhoea just as children, calves and lambs do when "chilled through and through" by exposure to cold and wet. The thick coat of fat of hogs furnishes them fuel for heat and gives some protection from cold; but it is neither healthful for the hog nor economical for the owner, to burn too much hog fat to keep the herd half way comfortable on cold nights. It is quite important to prevent, as much as possible, the common ailments mentioned above, in order to more successfully combat hog cholera. The congested and inflamed condition of the air passages, and the alimentary tract produced by exposure to winter storms, are conditions, especially favorable to contracting cholera, if the herd should become exposed to that disease. The resistance of the body is not only lowered so that the hog contracts cholera more readily, but serious complications are more liable to result, such as rupture of blood vessels in the lungs or bowels, and the development of an extensive pneumonia, or a severe type of bloody dysentery that will prove fatal to the animal.

Nothing can be much worse than to allow the hogs to sleep on manure piles and around straw stacks. The overheating of some of the hogs, and the subsequent exposure to cold can hardly fail to give them a severe attack of pneumonia. Anti-hog-cholera serum will not prevent deaths from cholera in such cases. Proper housing and sanitation will in most cases save the hogs and prevent the expense of the serum bill. The financial losses from lack of proper shelters, in many instances greatly exceed the cost of providing these essentials to successful hog raising.

The practical requirements in supplying shelters for swine on the average farm are that the shelters shall be comfortable and sanitary, as well as convenient and not too expensive. The first two requirements relate particularly to the health of the animals. The hog shelters for winter should be constructed so as to prevent cold winds and rain from blowing in upon the hogs. A leaky roof, wet floors, and cracks in the walls on the windward side that permit cold draughts to blow directly on the hogs, invite lung troubles and losses from hog cholera. Wherever it is possible, advantage should be taken of natural wind-breaks in locating the winter shelters. A strip of timber, or an orchard, at the north, and a sloping southern exposure of the grounds are advantageous.

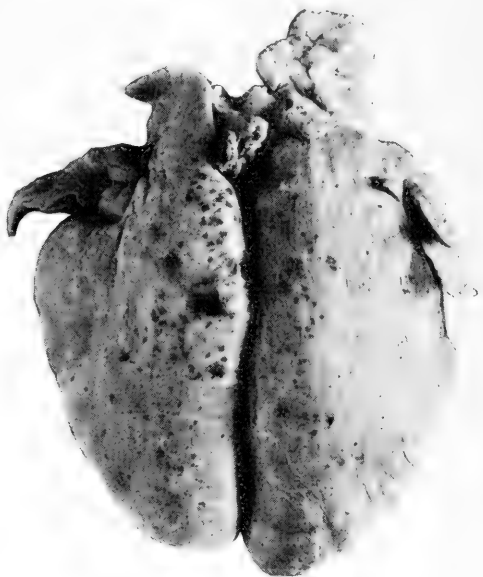
The shelters should be built so as to permit good ventilation, and access of sunlight in abundance to all parts of the interior. The aim should be to insure a moderate degree of warmth, dryness, and a proper supply of fresh air. The shelters should also be constructed so as to be easily cleaned and disinfected; otherwise they will not be kept in a sanitary condition. If the essentials mentioned, which are necessary for the maintenance of health, are kept in mind, it does not matter so much about the style of the hog house or the materials used. Cheap structures that have been used for other purposes can at times be converted into comfortable hog sheds without much expense. Plans and detailed specifications for the different forms of movable and permanent hog houses that have found favor with practical hog raisers can be obtained from the Animal Husbandry Department or from the office of the Agricultural Extension Service.

HOW TO KNOW HOG CHOLERA

Diagnosis.—In the control of any contagious or infectious disease the early recognition of its presence is of prime importance, in order that prompt action may be taken before it has gained great headway. This is particularly true of hog cholera, which is one of the most infectious of the animal maladies. The common impression among farmers and many veterinarians is that hog cholera presents a definite, unvarying train of symptoms, and that the "post-mortem" appearances in one case give a fair picture of what may be seen in all other cases of this disease; but the fact is that scarcely any other disease shows such a variety of symptoms, and disease changes in the internal organs, as is shown by cholera, including its complications.

Types of Cholera.—There are two general types of the disease, acute and chronic. In the acute form a number of animals of a herd may die suddenly or after a very short illness; while in the chronic type the animals often live for several weeks, become very thin in flesh and die, one or two at a time. The cause of the disease is the same in both types; the only difference being in the degree of virulence of the infection, or the difference in the resistance of individual animals, or herds. In many outbreaks and especially in the slow lingering type the disease first appears among the pigs and shoats. The very acute type often appears first in the heavy, fattening hogs.

Symptoms.—The following symptoms will be observed in nearly every outbreak of cholera, but not in every individual hog affected with the disease. Animals that succumb to the acute form of the



Blood Shot Spots on Lung in
Acute Cholera

disease show but few symptoms before death. They may eat well at night and be found dead the following morning. In other cases they may have a profuse diarrhoea, greenish, black or bloody in character; vomiting may occur, and bleeding from the nose, a reddening of the skin of the belly and legs may be seen. All these external signs may, however, be lacking in individual cases, but a "post-mortem" examination of such cases will as a rule show plain evidence of cholera. In the more chronic type of the disease the sick hogs cease to eat heartily, are sluggish, show an

inclination to burrow into the bedding and shiver as if cold, even in pleasant weather. After a few days the hair becomes rough, the skin becomes scaly or may show a reddening, either diffuse or in spots on the under surface of the belly. In prolonged cases of the disease ulcers may appear on the skin, especially about the joints. The tips of the ears in some cases slough off. The eyes become watery or show a "mattery" collection at the inner corner of the eye. The eyelids in some cases are glued together. Animals suffering from the chronic form fall off greatly in flesh, they become weak, especially in the hind quarters, and have an unsteady wabbling gait. Some of the sick animals develop a cough, and may show increased respirations; some affected in this manner bleed at the nose, some vomit, some have a profuse watery diarrhoea, the discharges in some cases being of a yellowish or ochre color, resembling the typhoid stools of man; in other cases the discharges are greenish or black in color, and at times quite bloody. Contrary to common opinion, many hogs affected with cholera suffer from constipation; and at death the large intestines may be found packed with hard lumps of almost dry dung. Hogs suffering from cholera have an inclination to eat dirt and gravel, and in some cases the stomach and intestines contain a large quantity of this material. "Thumps" is a symptom often seen in cases of cholera. The temperature runs high—104 to 107 degrees. The younger animals of a herd often contract the disease first and appear to be less resistant than adult hogs. This may be due to the fact that the pigs are more difficult to keep in an inclosure and consequently range more widely than the larger hogs and are more liable to come in contact with the infection from neighboring farms, and ingest a proportionately larger amount of infection than the larger hogs.

Importance of Post-Mortem Examinations.—Since some of the symptoms which have been given are common to other ailments, it is important to not rely wholly on these symptoms for a diagnosis. I cannot impress too strongly the importance of farmers and veterinarians making a post-mortem examination of the hogs that die; since an accurate diagnosis of cholera can by this means be more readily made; and the sooner it is made the better.

Too many farmers are inclined to think that because they have not had a medical training it would be useless for them to make the examinations suggested. In this they are mistaken, for some of the best descriptions of diseased conditions I have read were written by farmers who described in plain English the appearance of the diseased organs as they saw them. They did not know the meaning of the changes described, but it was easy for me to make a diagnosis from their accurate descriptions. Every farmer knows the common name and the natural appearance of the internal organs of the hog, and they should make themselves familiar with the changes that occur in cholera, since expert veterinary aid may not be available at the time when most needed. If uncertain as to the nature of the disease, they can refer their descriptions to an expert for interpretation. If the diagnosis is made on the first few pigs that become sick, much time will be saved in combating the infection.

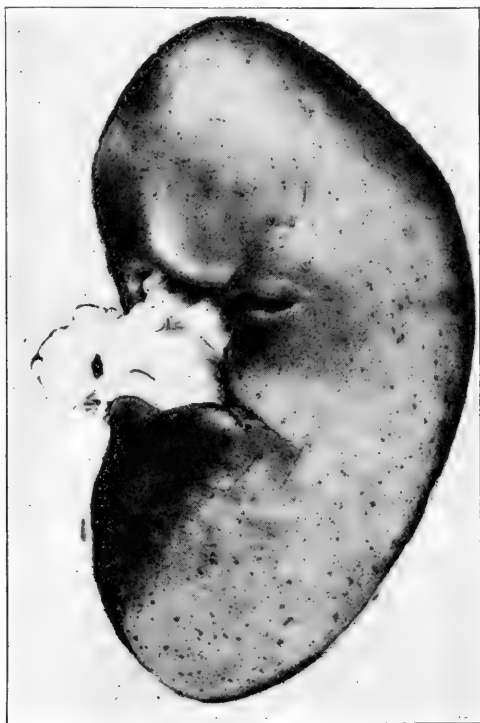
I shall now attempt to describe as clearly and as simply as possible

the methods of examining the carcass of a hog, and the appearance of the organs that show disease changes due to cholera.

It is essential to examine the carcass soon after the death of the animal, in order to avoid being misled by the ordinary decomposition changes that occur in the internal organs within a few hours after death.

First, examine the skin; observe whether there are any eruptions, ulcers, patches of redness on the skin of the belly ("blood-shot" spots or patches showing through the skin). The presence of these signs with the symptoms already given are indications of cholera. The animal may, however, have cholera without showing any eruptions or other noticeable changes in the skin.

Make a cut from the point of the chin backward along the midline of the neck, chest and belly to the tail, cutting first only through the skin and underlying fat. Peel the skin and fat well back on each side, examine the fat beneath the skin for hemorrhages, or "blood shot" discolorations. In the acute hemorrhagic type of the disease the subcutaneous fat is often the seat of numerous hemorrhages. In the fat of the flank region the hemorrhage is sometimes extensive. Mild cases of cholera show no disease changes in the subcutaneous fat. At the angle of the lower jaw beneath the skin will be found rounded glands, called lymph glands, which in



Speckled Kidney in Acute Cholera

the acute hemorrhagic type of cholera are often engorged with blood, giving to them a reddish, or even black color. In mild or chronic cases of cholera these glands may be enlarged, dropsical and of a normal grayish color. A few inches back of the glands mentioned other glands are located which may be highly engorged with blood. Tolerably large lymph glands are also to be found in the flank; observe whether these are engorged with blood and of a color varying from red to black. In some cases but little change occurs in these superficial lymph glands.

Next cut into the abdomen and expose the stomach, liver, intestines, etc. Before displacing any of the organs observe whether there are any

hemorrhages on the inner surface of the walls of the abdomen; note whether the intestines, large or small, show any spots of hemorrhages. In the acute type of cholera it is not uncommon to find portions of the small intestines thickly covered with small points of hemorrhage; and more frequently quite large "blood-shot" spots on the large intestines, and in the fatty membrane which binds together the intestinal coils. The outer coat of the stomach, in some cases, is also the seat of hemorrhages. The spleen may be enlarged and softened, or may be about normal size and show small blood spots on the surface, especially on the under surface.

The changes that occur in the liver are not such as would attract the attention of the average observer.

The kidneys in very acute cases frequently have numerous small blood points scattered over the surface, giving to the organ a speckled, "turkey egg" appearance. These small hemorrhages are more numerous on the lower surface. On cutting into the cavity of such kidneys, blood clots are often found. In mild or chronic cases the kidneys appear normal. The bladder may also be the seat of extensive hemorrhage, especially on the mucous surface.

In some animals which have died in the same herd, as those showing the hemorrhagic conditions mentioned, the outer surface of all organs examined may appear quite normal, and no suspicion of cholera would be aroused; but on examination of the mucous surface of the stomach and intestines positive signs of cholera are often found.

Remove the stomach and intestines and make an examination of the inner walls. This is best done by stripping away the fat which holds the coils of intestines together, then with a knife or a pair of scissors cut open lengthwise portions of the large intestines, beginning with the blind gut and continuing some distance along the large intestine. Wash away the dung carefully, without scraping the surface of the gut. The mucous surface of these parts in some animals that die of cholera appear to be in a healthy condition; in other cases, however, there will be seen, scattered here and there rounded ulcers varying in size from a fourth to three-fourths of an inch in diameter. The wall of the intestine at this point is thickened and the surface of the ulcer is elevated slightly above the mucous surface of the gut, and resembles a flat circular button, hence the term "button ulcer," which is applied to these ulcers. The presence of these ulcers can often be detected before cutting into the gut by the presence of a circular inflamed area on the outer surface. The thickened margins of the ulcer can be felt through the walls of the gut. In other cases there is a thick, yellowish, tough, cheesy-like exudate (diphtheritic membrane) covering the wall of the large intestine over considerable extent, and very firmly adherent. This is the result of a diffuse inflammation of the mucous and submucous membranes. The walls of the intestines in such cases feel thick and leathery. In the acute hemorrhagic type of the disease, extensive hemorrhages into the large and small intestines sometimes occur. So that on opening the gut, clots of blood, almost filling the cavity, are found.

On opening the stomach the mucous membrane in many cases appears

normal, in other cases it appears greatly inflamed, and sometimes blood clots are found.

Next examine the organs of the chest cavity. This cavity can be opened best by removing the breast bone. Cut through the cartilages where the ribs join the breast bone, press apart the ribs and note the condition of the lungs. In health they have a light pink color and collapse when the chest cavity is opened, and are soft and pliable to the touch. In many cases of cholera the lungs have a normal appearance. In other cases the lungs present a wide range of disease changes, varying from a few minute hemorrhages, on one or two lobes, to an almost complete solidification of both lungs. Frequently there is an extensive, straw-colored, coagulated exudate covering one or both lungs. This coagulum causes a slight adhesion of the lungs to the ribs; this adhesion is, however, easily broken down by the fingers. In prolonged chronic cases of cholera, white fibrous bands "pleuritic adhesions" are sometimes found binding the lungs very firmly to the ribs. These lung complications are often mistaken by farmers and by veterinarians for an ordinary pneumonia or pleurisy, and have also been called "swine plague."

The heart, in many cases, shows no signs of the disease. In others the walls are the seat of numerous spots of hemorrhage. These occur more often on the outer wall than on the inner surface, and



Large Intestine Ulcerated in Chronic Cholera

at the base of the heart, on the auricles, rather than on the ventricles.

In an outbreak of cholera, nearly all the diseased conditions mentioned have sometimes been found in the first one or two animals examined, and a positive diagnosis is quickly established. On the other hand, the first animal examined may reveal but little that is regarded as typical of the disease, and a failure to diagnose the trouble may result if another hog or two are not examined. It should be remembered that cholera is primarily a blood infection, and death may occur without any marked visible changes in the various organs of some of the affected animals. The presence of intestinal worms in a case of this kind has more than once misled farmers and veterinarians to an incorrect diagnosis.

The opinion has prevailed for many years that two wide-spread infectious diseases exist among the swine of the country. One called "hog cholera," affecting principally the intestinal tract, showing typhoid symptoms and ulcerations, the other called "swine plague," and marked by a more or less extensive congestion or inflammation of the lungs. While it has not yet been definitely proven, the indications are strong that we have but one disease, and that the differences which have led to the two names are simply complications of the one infectious malady. In a somewhat large experience I have always found both intestinal and lung complications in different animals of the same herd, and often in one and the same animal. In experimental cases, hogs that have been immunized against "cholera" by the "hog-cholera-serum" do not contract "swine plague" when exposed to hogs suffering from that type of the disease. Moreover, the inoculation of healthy pigs with infectious blood from an animal suffering from one type, may produce the other type of the disease. I am confident, therefore, that for all practical purposes it will be wise to quit using the term "swine plague," and apply the popular name "hog cholera" to every outbreak of an infectious swine disease, in which large numbers of hogs die; for it is probable that the true infectious agent in every outbreak of an infectious swine disease in this country is the "filterable virus" of hog cholera, the existence of which was demonstrated by Dr. Dorset and associates. It is, however, probably true that the ulcerations of the intestines and their typhoid condition are partly due to the associated action of the ordinary colon bacillus, or to the bacillus described by Salmon and Smith as the hog cholera organism, and that the "pneumonic complications" are partly due to the associated action of what has been called the "swine plague bacillus." With the evidence available, we must, however, regard these associated bacteria as harmless under ordinary conditions. They probably invade the tissues of the body only after the "true virus" of cholera has prepared the way.

WHEN TO VACCINATE AGAINST HOG CHOLERA

An infected herd should be vaccinated as soon as possible after recognition of the disease. Prompt treatment at the beginning of an outbreak in a herd will save most of the animals, while a few days' delay increases the percentage of loss. An early diagnosis is therefore important. The signs of the disease are sometimes so evident that the

farmer recognizes the disease without expert aid. At other times the diagnosis is difficult, then the services of an expert should be secured. In the meantime the sanitary precaution—isolation and disinfection already recommended—should be observed in order to prevent a possible disastrous spread of the disease.

When vaccinating an infected herd, all hogs that are apparently sick should be separated from those that seem to be healthy, and the sick hogs should be isolated in comfortable quarters for special handling, and to prevent the spread of cholera infection.

Temperatures should be taken of the apparently healthy hogs and any of these that show an abnormal temperature should be separated from the others. The hogs that show no evidence of sickness should be vaccinated with the regulation dose of serum; or from a fourth to a half more serum than the regulation dose should be used, if the disease is well developed in some of the other hogs of the herd. The group that shows an elevation of temperature, but no outward symptoms, should be vaccinated with a larger dose than that required for healthy swine of the same size—from a half to three-fourths the quantity should be added. This group should be kept separate from the others and put on a more restricted diet. The group of visibly sick hogs should have special handling; the animals that are evidently beyond all aid should be slaughtered and burned. Those that still eat should be put on a restricted liquid diet and should receive a double dose of serum. Valuable pure bred breeding animals have been saved in this way. Internal medication may also be given—according to the individual indications, but frequent and rough handling should be avoided.

As to whether the herd on adjoining farms should be vaccinated will depend upon the degree of exposure to the infection. If the herd on the adjoining farm is some distance away from the infected ones, and well isolated so that no communication with the infected farm is liable to occur, vaccination may not be necessary. Good breeders have frequently been able (before the days of vaccination) to isolate an infected show herd so that the home herd was not endangered. But where there is any special risk of the disease spreading to a neighboring herd, such herd should be vaccinated. The proper sanitary measures mentioned in preceding pages if applied on the infected farms will lessen the dangers of the cholera infection spreading to the adjoining farms, and this is more important than vaccinating all the hogs in the neighborhood.

It is usually advisable to vaccinate the hogs on farms lying on a lower part of a stream, if an outbreak of hog cholera has occurred on a farm up the stream. But if the outbreak is recent, the prompt removal of all the herds away from the stream may save both the hogs and a serum bill.

WHEN NOT TO VACCINATE

When a lot of feeding hogs are about ready for market and an outbreak of hog cholera occurs nearby, it is usually advisable to ship them, if the markets are favorable, rather than to vaccinate and hold them a short period.

There are other occasions when it is neither advisable to vaccinate nor to dispose of the hogs. Farmers have been advised by official bulle-

tins to vaccinate their herds when the disease is within two or three miles of their farms. This is rarely necessary, since the disease can be checked if proper sanitary measures are promptly applied on the infected farms. The efforts should be directed to these infected farms rather than to the remote healthy herds.

Those who advise such extensive vaccination have evidently given but little thought to what it means, in the way of expense and the possibilities for evil, for the advice was also to use the "simultaneous method" on these farms where the disease had not yet appeared.

There are other good reasons why the farmers should not vaccinate their herds under these circumstances: First, on account of the unnecessary cost; second, on account of the great probability of spreading the disease to many other farms now free from the disease. A third and important reason is that there are better and cheaper ways of eradicating the outbreak and protecting the herds that are even much closer to the infected farm than two or three miles.

A little calculation will show the inadvisability of vaccinating under the conditions mentioned.

Let us suppose that an infected farm lies somewhere near the center of a county. Measurements three miles to the north, east, south and west of the infected farm will cover an area of 36 square miles, or a geographical township, or 36 land measure sections of 640 acres each. In this state there is an average of five farms to the section, or 180 farms in the township. This means that 179 farmers who have healthy herds have been advised not only to vaccinate their hogs because the disease is within two or three miles of their farms, **but they are advised to inject hog cholera germs into their hogs**, along with the anti-hog cholera serum, in order to secure a more lasting immunity. And this in face of the fact that several new centers of disease would be established.

As to expense, in any good hog raising county in Missouri the number of hogs raised or fed on the farm runs from 10 to 100 head or more. The average in the hog raising and feeding districts is not less than 25 hogs to the farm, or 4500 to the township. The serum and virus bill, as shown by the official figures from one state, that has used the simultaneous method extensively, puts the average cost at 60 cents a head, on a half million hogs. But, if we put it at 50 cents per hog taking all sizes into account, the total for a township will be \$2250. The veterinary fees of 10 cents per head or \$2.50 per farm would add \$450 more. If we take into account the shrinkage in a good many of the vaccinated hogs, while they are going through the vaccination fever period, of 15 to 21 days, and the less profitable use of food during this period, the inadvisability of vaccinating all the hogs in two or three miles of an infected herd is apparent, if a better way to avoid the dangers from hog cholera is available. Some farmers estimate that the shrinkage, and loss of feeding condition will average on a bunch of stock hogs or feeders at least 50 cents per hog, if the loss should be placed at 25 cents, the cost to the whole township with its 4500 hogs would be \$1125. A further loss would ensue from deaths following the "simultaneous" vaccination. Over a large territory the losses in individual herds are from zero to more than 90 per cent. The State Veterinarian of Indiana reported recently in one

of the Swine Journals, that one day in a ride of 91 miles visiting sick herds of swine—made sick from simultaneous vaccination—the lowest loss was 12 per cent and the highest was 94 per cent, in herds that were healthy when vaccinated. There were of course many farms that the veterinarian mentioned did not visit and on which the simultaneous vaccination had been used, without hogs dying. But it is probable that some of the hogs on these farms had sufficient fever and diarrhoea to infect the grounds with hog cholera germs. But if we accept the statements of the advocates of the extensive use of virus, that the general average loss does not exceed 2 per cent to 3 per cent, the total loss in the township under consideration would be 90 to 135 hogs on the 4500 hogs raised. If we place the loss at 100 hogs, of a hundred pounds weight, at 8 cents per pound, the loss would be \$800 which is certainly conservative enough.

The total of all these figures is \$4525, or something over a dollar a head vaccination tax, that the farmers are advised to pay for the privilege of raising hogs. This would not be so bad if there was any end to this special hog tax. But those who are interested in the sale of serum and virus seek to perpetuate this system. For the system cannot fail to multiply the number of infected farms. And the adjoining townships would soon be taken into the system. And it would continue to spread until the entire county is included.

The hog raising counties of this state vary in size from ten to twenty-five geographical townships. The average is fourteen and a half townships. Multiplying the above figures by this factor, the cost to the average county would not be less than sixty-seven thousand dollars, and it would cost the whole state five million dollars or more, when the virus system is spread all over the state. The advice to vaccinate when the disease gets within two or three miles, while doubtless intended for the benefit of the swine industry, is unwise and harmful, and if followed the serum-virus business would ultimately eat up all the profits of the hog raising business. The better way advocated in this booklet, which makes hog cholera control mainly an incident to better hog farm management, which includes inexpensive and effective measures of sanitation and the use of serum alone will in the end be more satisfactory to the swine raisers.

A Good Tonic and Worm Preventive

The following is a good mixture to keep before the hogs all the time as a tonic and worm preventive: "Sal soda, 3 pounds; Glaubers salts, 3 pounds; copperas, 3 pounds; common salt, 3 pounds; sulphur, 1 pound; charcoal, 4 pounds. Mix thoroughly and keep in a trough in a shed.

Feed a Balanced Ration

Hogs do better when fed a balanced ration. For dry lot feeding try 1 part oil meal to 6 parts corn, or 1 part tankage to 10 parts corn, or 1 part corn to 3 parts shipstuff. A balanced ration and good forage will cheapen pork production very materially.

A Plan of Organization

GEO. B. ELLIS, MANAGING EDITOR THE MISSOURI FARMER

In the preceding pages of this book practically every important phase of "How to Control Hog Cholera" has been made thoroughly plain, but for carrying these suggestions into effect and finally to completely control and possibly eradicate hog cholera all together will require co-operative effort among the farmers, first by neighborhoods and followed by organization of the township, county and state.

The plan of organization which is herewith outlined was worked out by Dr. J. W. Connaway in co-operation with the department of farm management, Missouri Experiment Station and the same general plan may be followed by the farmers of any county in any state in the Union. While it is always advisable to put on a campaign in a whole county, where that is not feasible a single school district or a township can rid the smaller unit of loss equally well except that there is greater danger of renewed infection from adjoining districts.

Following is the way one Missouri county was organized and the good work accomplished: One week only was available for preliminary work and petitions were sent out to 100 active farmers who secured signatures. This is the form of the petition:

"Whereas, the Farm Management and Veterinary Departments of the University of Missouri offer to assist in eradicating hog cholera from our county, provided there is interest enough among the farmers to warrant the undertaking, we, the undersigned, agree to attend a meeting at on for the purpose of having this proposition explained to us, with the understanding that we do not obligate ourselves to take any action whatever. When we have heard the plan explained, we shall co-operate further if we approve of it; otherwise the matter is at an end."

Just a week after these petitions were issued they began to return to the office of the county agent, it was found that the petitions contained the names of over 1200 farmers out of a total of 3600 in the county.

Meetings were posted in twenty-one places in the county and at these meetings four or five of which were held in a day, the symptoms of hog cholera and methods of sanitation and control and, also the use of serum were explained. After this educational campaign was ended an agent of the Experiment Station was put in the county to meet with these 21 clubs that had been organized and to visit infected farms in the county and to advise and assist the farmers in vaccinating their hogs and in disinfecting and cleaning up the premises.

Under this plan of organization if an outbreak of hog cholera occurs in a neighborhood the fact is at once telephoned to the office of the agent at the county seat and he at once makes an inspection and if it is found that it is cholera the badly diseased animals are killed and burned, the others are vaccinated, the yards and pens are disinfected and the neighbor's hogs carefully watched until there is no further danger. Thus from farm to farm, neighborhood to neighborhood the agent goes until the whole county is free from the disease.

The money saving to the farmers of the county is given in a statement by the County Farm Agent as follows:

"It might be of interest to know what the losses were from cholera in our county in the three years previous to this campaign. Cards were sent to the school teachers, asking them to send one to each family, in order that we might get a report of the losses from this cause. There were 836 farmers who responded to this request. As these farmers were

widely distributed

throughout the

county, we think

they are representative

of the cholera situation

in the county. If

they are, the loss

from cholera

in the last three

years was \$116.76

per farm for the

3681 farms in the

county. However,

not every farm in

the county lost

hogs from cholera.

Based on the

above figures, the

loss for just those

farms that lost

hogs from cholera

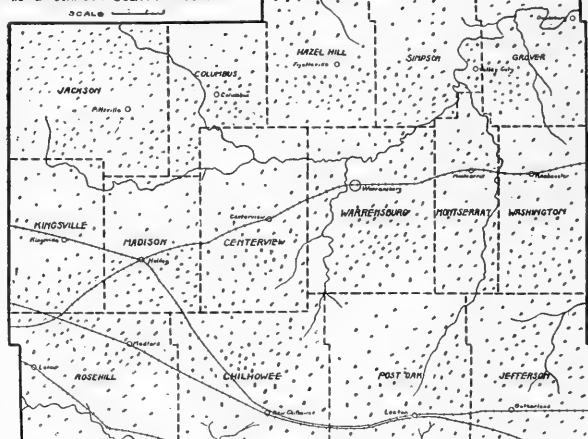
was \$495 per

farm for these

three years, or a

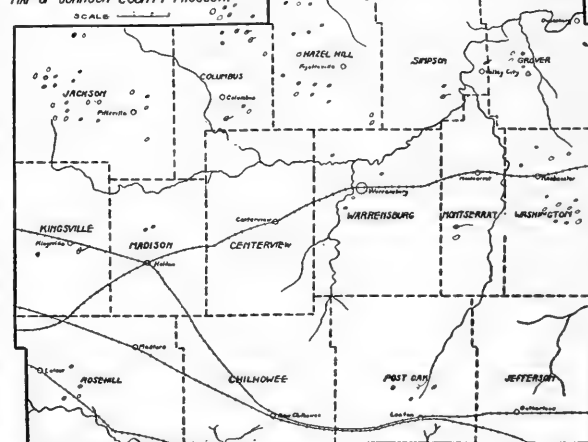
total loss in the

MAP OF JOHNSON COUNTY MISSOURI



Map No. 1. Showing distribution of hog cholera before the anti-hog-cholera campaign was started by the County Farm Bureau under the direction of Dr. J. W. Connaway, Veterinary Department, University of Missouri.

MAP OF JOHNSON COUNTY MISSOURI



Map No. 2. Showing distribution of hog cholera and herds treated from Oct. 1, 1914, to March 21, 1915. The open circle (o) indicates farms where the herds were treated for protection. The solid (.) shows where cholera was found during these six months. Compare these two maps to get the value of the clean-up work.

"At the time the county agent finished visiting members of the 'Anti-Hog-Cholera Clubs' there existed some five or six infected spots in the county, but these were under control and cholera soon disappeared, and for the four weeks from the date this work ceased up to now (August 15) there has been no cholera within the borders of our county.

"We do not think we are rid of cholera—in fact, we expect it to break out from time to time—but with the organization among the farmers we believe it will not become widespread again. The cases are reported promptly and we immediately take steps to keep them under control. The farmers themselves are fighting it by better feeding methods, better sanitation, and by eradicating parasites. The total cost of this campaign was \$933.19."

Map No. 1 on the previous page will give you some idea of what the proposition was when the county agent, under the able direction of Dr. Connaway and assisted by a well trained young farmer, organized more than twenty 'Anti-Hog-Cholera Clubs' and began the fight to control cholera in Johnson County. This map shows the condition before the hog cholera control work began. From a careful census of the county the county agent ascertained that the loss from hog cholera in Johnson County for three years previous to the time of this clean-up work amounted to approximately \$116 per farm on the average or a total loss for three years of nearly \$450,000. Now turn to Map No. 2 and observe the cholera infected farms found in the nearly six months, Oct. 1, 1914, to March 21, 1915. It will be observed from the legend under the map that about half of the farms indicated were not infected farms but on these farms the hogs were merely treated with serum as a means of protection. According to the reports the losses have been reduced from an average per farm of \$116 to \$6.25 per farm; quite a nice sum saved to the farmers of that county.

A look at Map No. 2 shows that nearly all the infected farms for the last six months have been in the northern part of the county. Across the line in the adjoining county to the north there is no organized work for the control of hog cholera. In this territory it is reported that a great many farmers use the simultaneous method and that there has been a great deal of cholera in that territory. This shows very clearly what it would be worth to have the entire state all under close organization and strict supervision so that sanitary measures could be enforced. With the kind of work they have done in Johnson County extending to every county hog cholera could be put under control and practically exterminated inside of two years.

This co-operative control work in hog cholera will lead farmers to co-operate better for the eradication of other contagious diseases, crop pests and other troubles which are taxing the farmers of this country about to the limit of their endurance.

In the organization of this work the banker, the merchant and the professional man can lend a helping hand and be of great service to his county and incidentally put himself in closer and more friendly relations with the farmer. The farmers of this country can not sustain a loss of \$60,000,000 from hog cholera without the business interests of the country sharing in the loss.

Profitable Pork Production

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Introduction.—The ever increasing value of land and the problem of keeping up the fertility of the same demands that more attention be paid to all kinds of live stock. This is especially true of hogs since they are a product that is usually carried from birth until marketed by the same man or his neighbors. Pork will be in the future, as it has been in the past, the most profitable manner of marketing the great corn crops of the Mississippi Valley. This is especially true in the case of the small farmer who understands the importance of maintaining the fertility of his soil by returning to the soil its fertility by the feeding of the crops on the land that has produced them, but who cannot afford to put a large amount of capital into equipment and breeding stock. No other domestic meat-producing animal will reproduce itself as quickly nor in such great numbers as the hog. Neither will any other domestic animal, except young lambs, make so economical gains during the fattening period as the ordinary porker.

Raising Young Pigs.—The greatest problem with which the hog raiser has to deal is the production of the young porker up to the age of three or four months. This includes not only the care of the young pig but also that of the sow producing the pig. With the possible exception of better pastures, nothing will increase the profit of hog raising in the state more than better care and attention of the brood sow and her litter.

Feeding Growing Animals.—In order to grow the pig successfully it is necessary to begin with the mother. The fact should be recognized that the brood sow, whether pregnant or suckling pigs, is being called upon to manufacture from common feeding stuff, the bone and muscle for her growing young. In other words, she is a machine transforming one kind of material into a substance of the same material, but of entirely different form. In doing this the machinery, her body, must be kept in proper running condition and the raw material, the food, must be of the proper composition to furnish the finished product, the pig, with the necessary food elements.

Of prime importance to growing pigs, and all other growing animals, is the question of bone and muscle forming feeds, for until the age of four months, the desire of the hog raiser is to grow rather than to fatten the pig. Only the feeds containing an abundance of ash can furnish the nutrients required for the formation of bone; only feeds containing an abundance of protein can furnish the nutrients necessary for the formation of muscle. The growing animal must, therefore, have a ration containing a high percentage of protein and ash. The fat and starchy feeds, and also protein, are used for the production of energy and heat and for laying on fat. In other words, the ash and protein feeds are used for making machinery and repairing the old or worn part, while the fats and starches are used for the fuel to run the machinery and for storage of energy in the form of fat. As the object of the feeder is to grow rather

than fatten the pig or pregnant sow, the per cent of fat-forming food should not be as great as when the fattening period is reached.

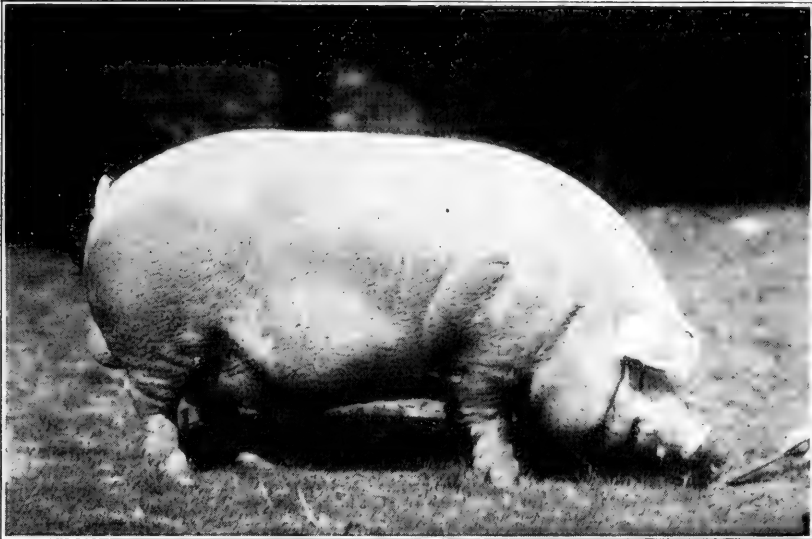
In addition to the question of food nutrients which influences all growing animals, there are other factors affecting the food of the brood sow, one of which is the laxative effect of the food given the pregnant female. Not only is she the provider of food, but her body is the guardian and protector of the unborn young. Any cause that may result in a derangement of her body will probably result in the death or serious injury to the young. A food that constipates a pregnant sow will cause a week, sickly litter. Not only must the sow receive a laxative food but she must take enough exercise to insure the proper passage of all refuse food stuff from her body in the form of feces. This is such an important factor that it may mean the success or failure of the litter, for a sow that does not have, during pregnancy, a free passage of waste matter from her body cannot produce a strong, healthy litter.

The question of the bulk of the feed is often of great importance, especially in the feeding of brood sows. The appetite of any animal is not satisfied until the stomach is full. A food that is very concentrated, such as the grains, etc., contains so much nutritive value that feeding so as to satisfy the appetite on such feeds results in the brood sow getting very fat. As it is not desirable to have this occur, the only way to prevent this, and at the same time satisfy the appetite of the sow, is to feed a more bulky ration. This is very easily accomplished during the grass season when pasture is available, but in winter it requires the feeding of more than the very concentrated grains or feeding stuffs.

The following table of the composition of the more common feeds on the farm represent the different properties desired for feeding stock. The muscle and bone forming elements are represented by the protein and ash contents, respectively, the energy and fat producing elements by the starch and fat content, while the bulk is represented by the crude fiber and water content:

	Water per cent	Ash per cent	Protein per cent	Starch or sugar per cent	Fat per cent	Fiber per cent
Corn	10.6	1.5	10.2	70.4	5.0	2.2
Milk	87.2	.7	3.5	4.9	3.7	...
Fresh clover	70.8	2.1	4.4	13.5	1.1	8.1
Fresh alfalfa	71.8	2.7	4.8	12.3	1.0	7.4
Bluegrass	65.1	2.8	4.1	17.6	1.3	9.1
Bran	12.3	5.9	16.0	53.7	4.0	8.1
Middlings or shorts	12.1	3.3	15.6	60.4	4.0	4.6
Linseed oil meal	9.2	5.7	32.9	35.4	7.9	8.9
Tankage (variable)		8 to 20	60.	....	8.	..

In studying this table the fact should be borne in mind that it is the proportion of ash and protein to starch and fat that determines the nutritive ratio instead of the actual per cent of each nutrient. While the laxative effect cannot be reduced to figures, the relative power is well known. The feeds, excepting the green grasses, all of which are laxatives, stand in the following relation to each other as to laxative effect, the more laxative being placed at the head of the list: Linseed oilmeal,



Chester White Boar

bran, milk, tankage, shorts. Corn instead of being a laxative is somewhat constipative except when fed in very large amounts.

It will be noted that our principle feed, corn, is lacking in protein, ash, bulk and laxative effect, all of which are necessary for the best development in breeding and growing stock. This defect, however, can be easily remedied in summer by a good pasture of clover, alfalfa, and to a great extent, by bluegrass; and in winter by the use of other feeds in connection with corn, such as leguminous hay, milk, bran, oilmeal, and shorts or tankage, the last three of which, however, are lacking in bulk for brood sows not having access to pasture or bulkier feeds.

Another factor that often means success or failure, is that of exercise for the brood sow and litter. It is almost impossible to keep in good condition the digestive and reproductive organs of breeding and growing stock that do not have sufficient exercise. It not only tends to cause them to fatten, but it also leaves the digestive tract closed and leads to constipation and other disarrangements of the system which, occurring in the pregnant sow, cause weak and sickly litters to be farrowed. Ordinarily it is no trouble to get sows or pigs to take sufficient exercise, except in very bad weather, especially if a winter pasture, such as wheat or rye, is provided. But should a sow become sluggish and refuse to take a fair amount of exercise, some means of compelling her to do so should be resorted to.

The Unbred Sow.—Until the sow is bred the care and management is very simple. She is in a state of storage, so to speak, for future usefulness. If she has not been suckling a litter or for any other reason is in medium flesh, she requires very little grain if on a good pasture and this grain may consist almost entirely of corn provided the pasture is of a leguminous nature. If there is no pasture available the feed should con-

tain some bran or shorts or from 5 to 10 per cent of oilmeal or tankage or meat meal. The sow should not be in very heavy flesh but be gaining when breeding time comes. It is easier to get a sow to take the boar and to conceive if she is in only medium flesh and gaining in weight when bred. If a sow is producing two litters yearly barely time is given between weaning of pigs and breeding time to get her to gaining well before breeding, so that there need be no material change in her feed after the pigs are weaned.

The Pregnant Sow.—From the time the sow is bred until a few days after farrowing time is the period when she exerts her greatest influence over the offspring. The feed during this time should, therefore contain the material to form the muscle and bone of the young undeveloped pigs and at the same time not get the brood sow so fat that she becomes sluggish. Corn is too cheap and common to be entirely omitted from any ordinary feeding ration, but the cheapness of corn, which is a fattening rather than a growing feed, must not over-balance everything else. The effect of a ration of corn upon the development of the internal organs has been shown to be that of a fattener rather than a developer. In a trial to test this matter the heart, liver, spleen, and kidneys did not develop as well and the amount of fat deposited upon them was greater when a ration of corn alone was fed than when bran or cowpeas was added to it. Animals made fat on corn alone contain more internal fat than those fattened on a more nitrogenous ration. Therefore, brood sows may be kept much fatter on a mixed ration without injury than on a ration of pure corn. It is a well known fact that farmers who feed sows very little except corn, prefer to have their sows in a much thinner condition than those who feed a ration containing more protein in proportion to the starch in the food.

The ration for the pregnant sow should consist if possible of a good pasture. If pasture is good, a limited ration of corn alone will keep the sow in good condition. Feed of this kind is good in that the pasture, if leguminous, furnishes bulk, protein, and laxative effect, while the corn gives a concentrated ration. One of the best methods of management is to have a rye or wheat field or bluegrass pasture to use in winter, thus getting the sows to take sufficient exercise.

If no pasture is available a mixed feed containing some bulk and laxative constituent should be fed with corn. A few good rations are:

Corn 60-65%, shorts 30%, tankage 5-10%;

Corn 60%, shorts 30%, oilmeal 10%;

Corn $\frac{1}{3}$, shorts $\frac{1}{3}$, bran $\frac{1}{3}$;

Corn $\frac{1}{3}$, shorts $\frac{1}{3}$, oats $\frac{1}{3}$.

These rations have proven very satisfactory and are examples of how the feeds should be mixed. No matter what other feeds are used if alfalfa, cowpeas or bright clover hay is available, it should be kept before them at all times. It is best to keep this hay in racks much the same as for sheep except that the racks rest on the ground so the hogs can get to the hay. Good alfalfa hay and corn alone make a good ration for brood sows especially when they are not being kept in very high condition.

The houses should be dry and well bedded and the sills low enough that the belly of the sow passes over them without difficulty. If there



Poland China Boar

is no pasture over which the sow roams to get exercise, the house or cot should be at the opposite end of the lot from the feeding place, thus, making the sow take exercise.

Care of Sow at Farrowing Time.—The care and management at farrowing time is very important for then is one of the most critical periods in the production of pork. This is especially true if the numbers of sows kept is so large that they are crowded in the least for room. The care at this time depends very largely upon the animal and the weather conditions. If the sow is in good health and vigorous, there is usually no trouble to be feared. She should be placed in her farrowing quarters a few days before she is due to farrow in order to let her get accustomed to them. The feed should be limited for a day or two before farrowing, and should be of a laxative nature so as to prevent any tendency toward constipation. Ordinarily it is better to leave the sow to herself than to try to help her, which in her fevered condition excites her and often causes her to trample upon or mash the pigs.

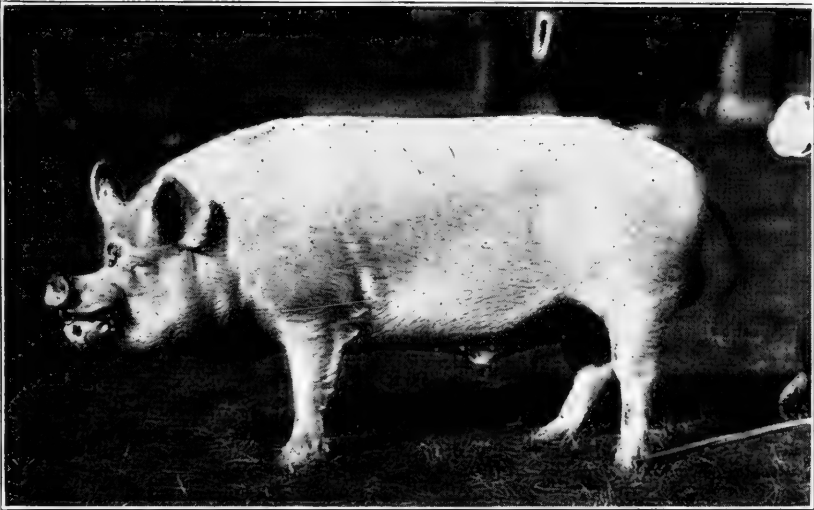
The mashing of the pigs is the most serious danger to be feared at this time. It is impossible to entirely prevent the loss from this cause, but the conditions that will reduce it to a minimum are to have the sow in good physical condition; let her receive only a small amount of warm laxative feed for a day before farrowing and have her placed in quiet, comfortable quarters. In the farrowing pen, from which the other hogs

are excluded, there should be a rail set eight inches from the floor and six to twelve inches from the wall. This prevents the sow from lying too close to the wall, and gives the pigs a chance to creep under the rails for protection. The floor should be smooth and level and have only a small amount of bedding which should be fresh and clean. A large amount of bedding prevents the pigs from moving freely to escape the sow and also works under the protection rail. If the weather is not cold the sow should be left alone. If cold, a lantern in the individual house keeps it much warmer. It sometimes proves useful to have some way of warming the pigs, such as a warm blanket with a jug of hot water or a hot stone wrapped in it. The pigs can be placed in a basket and wrapped in this blanket until the sow has finished farrowing and then placed to the teats and be warmed by the milk. The after-birth should be removed from the pen because it is believed that some sows are started to eating pigs by first eating the after-birth.

Sow and Litter.—From the time the pigs are born until weaned the sow is under the heaviest strain and needs a pretty good feed to prevent her from getting poor. For a few hours after farrowing, the sow needs no feed other than water which has been warmed enough to have the chill removed. After twelve or twenty-four hours she should receive a warm feed of medium to thin slop of some ground feed, or milk. Very little corn should be fed at this time as it is very heating and may increase the fever. The feed should consist as nearly as possible of the same ingredients as was fed before farrowing. The feed should be increased as fast as the pigs can use the milk. The feeding of cold feed or water to newly farrowing sows often causes indigestion or chill that retards the flow of milk. Too heavy feeding for the first few days may result in too sudden stimulation of milk flow, which scours the pigs and causes their death or injury. Pigs that have been scoured by too heavy flow of milk or by fevered condition of the sow very seldom make as good growth as if they have not been thus injured and are often killed outright. After the pigs are large enough to use all the milk, the more milk producing feed used the better. The rations mentioned for the pregnant sow do well for the sow at this time. The milk producing feeds should be reduced as the pigs get near weaning time and more corn used in the ration, which should be greatly reduced, thus gradually causing the sow to "dry up."

While the pigs are small, care should be taken that the quarters are clean, as dirty quarters as well as too heavy feeding cause scours in pigs. Exercise is also essential as lack of it with heavy feeding usually causes constipation which leads to thumps. For this reason the sow and litter should not be confined to a small pen or be fed at the same place as quartered. The benefit to be derived from short walks from the house to the feed trough is surprising. Getting the sow and pigs into the sunshine is very essential to proper growth during the spring and fall.

Until the pigs have reached the age of three or four months they should not be made excessively fat, especially if they are of a very early maturing type, since they may become fat and "chubby" before they have reached a desirable size, and after reaching such a condition it is usually unprofitable to try to carry them to a very much heavier weight. For



Yorkshire Boar

this reason it is desirable to make young pigs grow rapidly rather than get too fat. Therefore, there should be an abundance of muscle and bone producing feeds and a large amount of exercise. This is especially true if any of the young stuff is to be kept for breeding purposes.

When the pigs are about three weeks old they will begin to use feed other than the dam's milk. At first they nibble at grass or taste of the sows food until soon they are eating a large enough quantity to justify giving them some feed of their own. Shelled corn is one of the easiest feeds with which to teach pigs to eat but should not be their sole feed when they have learned to eat well. The pigs show their greatest response to a balanced ration before they have reached the weight of 125 pounds. Milk is about the best feed that can be given pigs. A slop of corn meal, shorts, and tankage or oilmeal give very excellent results. The rations should be compounded of some of the following feeds, always using corn as the basis:

Corn	not more than 90%
Shorts or shipstuff.....	not more than 50%
Milk	no limit
Oats	not more than 33⅓%
Wheat	not more than 50%
Oilmeal	not more than 20%
Tankage	not more than 10%
Meat meal	not more than 10%
Bran	not more than 33⅓%

These feeds should be fed in a small enclosure near where the sow is fed but with openings in it too small for her to enter. The opening or creep should be so that the pigs go between vertical boards rather than under horizontal ones. Also, by all means, a pasture of clover, alfalfa, cowpeas, bluegrass and white clover, rape, or other green feed

should be furnished. No other investment pays like a good pasture for hogs. When weaning time comes the pigs must be eating well. Remove the sow from the pasture and place her in dry lot with very light feed of corn for a few days to stop the milk flow without caking the udder. She may be returned once a day for a few days to let the pigs milk her out well. A few of the runt pigs may be allowed to go with her or the large pigs may be removed to another pasture and leave the sows in the pasture with the small pigs. The weaning should usually be done when the pigs are 8 to 10 weeks old.

No matter how the weaning is done the feed of the weaning pigs should be of practically the same nature as was fed before weaning. If good pasture is available more corn can be used than otherwise but if dry lots are used as in the case of fall pigs a mixed feed is essential to best results. Often in dry lots the gains can be doubled on weaning pigs by feeding corn 60%, shorts 30%, tankage 10% instead of corn alone. When a slop is fed the best results can be secured only when the pigs of the same size are fed together, otherwise the larger ones crowd out the smaller ones that soon become runts. A creep for the small pigs helps some in a case of this kind but is not entirely satisfactory. Always keep the trough clean. The pigs do better if the troughs are clean and do not run as much risk of getting disease. Give them a dry place to sleep. A large amount of bedding is not necessary if the shelter is dry. The houses should be free from dust which is very detrimental to pigs. Give plenty of exercise, pasture and sunshine.

PASTURE FEEDING OF HOGS

The fattening of hogs may be safely divided into two periods—dry lot and pasture feeding. The cheaper time is that when pastures can be secured. Probably as large a loss as occurs in the fattening of hogs is in the failure to provide the proper kind of pasture for the fattening or growing hogs. Numerous trials have shown that the gains received from a bushel of corn can be increased from 20% to 50% and in some cases 100% by the use of a good pasture.

The best kind of pasture to use is shown by the answers to a question submitted by the author to the best hog raisers of the state as to what they considered the best forage crop to grow for hogs. Of 159 replies, 114 gave either clover, alfalfa, or cowpeas as the most profitable forage, and 21 other replies mentioned one of these three in connection with some other crop, leaving only twenty-four stockmen preferring non-leguminous crops. Of these twenty-four twelve preferred rape alone and three others rape in connection with some other crop. Next in favor after these four forages came bluegrass and white clover.

Pasturing Clover or Alfalfa.—Clover is a good hog pasture. It furnishes an abundance of excellent pasture that supplies the necessary nutrients lacking in corn; it fertilizes the ground while growing; and it fits perfectly into a ration where corn is the principal crop. The general distribution and popularity of clover as a forage crop is due to its great adaptability to the conditions found in most states and there is no serious drawback to it as a hog pasture. There are, however, some pre-



Yorkshire Sow

cautions to be taken with it. It is, in addition to being a biennial, more easily killed by heavy pasturing than is bluegrass or timothy. If heavily pastured when small, the hogs eat off the crown and kill the plant, and too heavy pasturing at any season of the year may cause serious injury. If the clover is to be pastured heavily, the hogs should not be turned in until it is several inches high. Clover is at its best for hog pasture when heading or blossoming, but if the hogs are not turned in until the clover reaches this stage it will take a very large number to keep the pasture from getting too ripe. After the heads are ripe the plant is so woody that the hogs do not relish it as a pasture. When the plant is in this stage it should be cut and a new and succulent growth allowed to spring up. The clover can be pastured heavily enough to keep from getting woody but, when this is done, a dry spell is apt to cause its death. Alsike clover is better in some regions than red clover, especially in low moist ground. It will supply almost as much pasture as the red variety, if sown at the same time and furnishes pasture for about the same period.

Alfalfa is a feed of the same character as clover but is shown by the experience of its users to be somewhat superior to the latter as a hog pasture, both as to quality and amount of feed furnished. While an acre of clover will pasture from 8 to 12 hogs averaging 75 to 125 pounds, the same area of alfalfa will pasture 15 to 20 head of the same sized hogs. Alfalfa comes earlier in the spring than clover, and if kept from heading will make a green, succulent, nitrogenous forage from spring until heavy freezing comes in the fall. Not only does this plant give a good forage during the growing season, but the hay, especially the last cutting, will

furnish a high class roughage for hogs in winter and anyone who has used alfalfa hay for this purpose never fails to recommend it very highly.

The same precautions should be taken when pasturing alfalfa as when pasturing clover, i. e., the hogs should not be turned on before the pasture is well started, should not be pastured while the land is very wet, nor so heavily that the plant does not grow well, and should not be allowed to grow large enough to get woody. If the purpose is to use the alfalfa solely for pasture, the field should be divided and one part pastured while the other is growing. The common practice, however, is to allow enough pasture so that about two crops of hay are harvested each year while the hogs are using it for pasture. By cutting the halves of the field a few days apart, one part is furnishing pasture while the other is being cut for hay. In this way pasture is furnished for a large portion of the year.

Feeding on Clover or Alfalfa Pasture.—The composition and character of forage furnished by clover and alfalfa are so nearly the same that the best methods of feeding for one will apply equally well for the other. As neither of the two plants furnish enough seed for any considerable part of the ration, their feeding value as pasture rests on the forage alone. Both plants furnish an abundance of protein for the growing hog and make the very best material to balance a ration of corn.

For well grown hogs a ration of corn alone on clover or alfalfa pasture gives probably as cheap gains as any ration that can be fed. The class of hogs to which this applies is usually fall pigs that are well grown and not requiring a great amount of muscle production. The effect of feeding a supplement to corn on alfalfa pasture is shown by the results given by Nebraska Experiment Station in Bulletin No. 94 where three lots of ten 145-pound fall pigs were finished on alfalfa pasture, beginning May 14th and fed for 56 days on corn alone or different proportions of corn and tankage, which is probably the best of supplements to corn.

Ration with Pasture	Weight at end	Gain per pig	Daily gain	Grain per 100 pounds gain
Soaked corn	216	71	1.26	416
Soaked corn 95%				
Tankage 5%	229	85	1.51	371
Soaked corn 90%				
Tankage 10%	230	86	1.53	366

These results, as was expected, show a more rapid gain where a supplement like tankage was fed with corn, than with corn alone, thus making the hog come to a good marketable weight at a somewhat earlier age. It will be noted, however, that corn alone and alfalfa pasture made a gain of $1\frac{1}{4}$ pounds per day for a period of 56 days. The corn and tankage made a gain of little more than $1\frac{1}{2}$ pounds per day. The grain required to make 100 pounds of gain was much less when tankage was fed with corn than when corn alone was used, the amounts being 366 pounds for one-tenth tankage ration, per 100 pounds gain, 371 pounds for one-twentieth tankage ration, and 416 pounds for corn alone. With the price of corn



A Bunch of Hampshires

at 60 cents a bushel, and tankage at \$44 per ton, the cost per 100 pounds gain, not counting pasture, was \$4.45 for corn alone, \$4.18 for nineteen-twentieths corn, and one-twentieth tankage, and \$4.33 for nine-tenths corn and one-tenth tankage, thus showing a slight saving by feeding a small amount of tankage with corn. This experiment shows that if the extra work of providing and feeding tankage is not too great, and more especially when pastures are not very strong and corn is high priced it may pay to feed some kind of supplement with corn to hogs on clover or alfalfa pasture. As a general proposition, however, the margin in favor of a supplement to corn on clover or alfalfa, is not enough to justify the extra labor of securing and feeding it.

This is not the case, however, with small pigs. They cannot consume sufficient roughage to balance the corn they should eat in order to make the most rapid growth. For this class of hogs the best farmers have found that they get much faster and cheaper gains by adding a supplement to their corn. This, of course, entails the expense of extra time and labor but more than pays for the cost of extra gains. This is especially true where a rapid growth is desired. Of course, as the pigs get larger and more able to consume large amounts of roughage, corn alone can be more extensively used.

The time at which the hogs are to be marketed determines largely the best ration to feed young pigs on clover or alfalfa pasture. When it is desired to grow hogs only, without trying to fatten them, it is best to feed only an ear or two of corn daily per pig; when it is the purpose to "push" them from weaning time until finished they can be full fed

on pasture without the danger of too early fattening that there is where grain has to be depended upon to make the greater portion of the gain.

An excellent example of the two methods of feeding young hogs on clover or alfalfa pasture is given by a trial at the Nebraska Experiment Station where 90 forty-two-pound pigs were divided into three equal lots and fed for four months on light, medium, and heavy grain rations and then full fed until fat in dry lot. The results of this trial as reported in Bulletin No. 99 are as follows:

Lot	Days on trial	Weight at beginning	Weight at end	Gain per pig	Daily gain	Grain per 100 lbs. gain	Grain to fatten a pig from weaning time
1. Light fed	230	42	233	191	.83	377	12.86 bu.
2. Medium fed	221	42	236	194	.87	391	13.54 bu.
3. Heavy fed.....	165	42	228	186	1.13	395	12.80 bu.

Note that when the pigs were fed one pound of corn per 100 pounds weight for 119 days, and then full fed, it required 230 days to get ready for market; whereas, the pigs of the lot fed two pounds of corn daily per 100 pounds live weight for 119 days, and then full fed, required 221 days; and the pigs which were fed $3\frac{1}{2}$ pounds of corn daily per 100 pounds live weight for 119 days and then full fed, were ready for market in a total of 165 days, or $5\frac{1}{2}$ months from the time they weighed 42 pounds, thereby finishing the pig at seven months old, weighing about 225 pounds.

It will be noted that the finished weight of the hogs of these three lots varied only 7 pounds. The average gains made daily were .83, .87, and 1.13 respectively.

The grain required per pound of gain was 377 pounds for the light fed lot, 391 pounds for the medium fed lot, and 395 pounds for the heavy fed lot. This means that 12.86 bushels of corn was required to fatten a pig under the system of light feeding for the first four months after weaning, 13.54 bushels for the medium feeding system, and 12.80 bushels for the system of rather heavy feeding from weaning time. Under the three systems of feeding, then, we find that very light feeding on pasture and then heavy feeding at fattening time gives somewhat cheaper gains, pound for pound, than a heavy feed from weaning time, but that it takes two months longer by the first method to get the hogs ready for market. The time to have the hogs ready for market would depend on market conditions, prevalence of disease, etc. Moreover, the difference is so small that an expensive season for finishing hogs, such as the cold months of winter or the hot months of summer, can profitably be avoided by forcing the hogs from the start.

Pasturing Bluegrass and Timothy.—Bluegrass, in conjunction with white clover, and in some cases red clover, is a pasture that is found on practically every farm in central and north Missouri. Its popularity rests on its hardiness and the fact that it is a perennial, and once established is hard to kill out, and also makes excellent pasture. Neither is there the danger of scouring among hogs on bluegrass pasture that there is in some other kinds, such as young clover or alfalfa. Bluegrass also



Duroc Jersey Trio

comes early in spring and furnishes good fall and fair winter pasture. It should be pastured heavily enough to prevent any extra growth, because bluegrass that has become rank and growthy gets woody, and when in this condition is not a satisfactory pasture for hogs. There is a period of from two to three months during the summer just after seeding, when bluegrass is in its resting stage and is too dry and woody to give good hog pasture, and has to be supplemented with some other crop, such as clover, sorghum, rape, etc., that can be sown in spring and be ready for pasture by July. The resting period of bluegrass, coming at the time of year when the hot weather makes a green pasture all the more necessary for success in hog raising, is one of the most objectionable features about bluegrass as a pasture for hogs, and every farmer should prepare for this period by providing some other kind of pasture.

The value of timothy as a pasture is hardly as great as that of bluegrass, for the reason that bluegrass is suitable for pasture much earlier in the spring and will last much longer in the fall, and also contains white clover, which is seldom found in timothy. The timothy, however, does not get as tough as the bluegrass and will spring up sooner after being cut, thus shortening the period of rest in mid-summer. Timothy, however, when it begins to joint, gets woody unless cut when very green, and when managed in this way is not long lived.

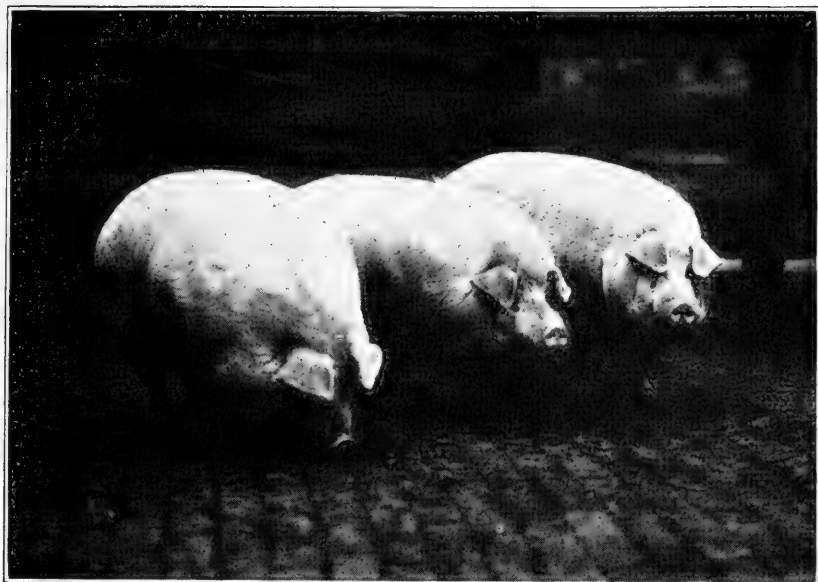
Feeding Spring Pigs on Bluegrass and Timothy.—The feeding value of the two grasses as a pasture are so near the same that the best method of feeding on one kind will apply equally well to the other kind of pasture. Both timothy and bluegrass are lacking in protein, which is used to form muscle and bone. Clover, however, is well supplied with

this material, and when mixed with timothy or bluegrass, makes a well-balanced pasture. Corn, which is also lacking in protein, does not make the best feed for hogs on a pasture consisting wholly of timothy or bluegrass. Clover in the pasture, however, furnishes the necessary nutrients for growing stock. When there is not enough clover in a pasture to furnish a large proportion of the forage, there is a need, especially with shoats, for a feed consisting of more than corn alone. The amount of clover available determines to a large extent the needs for these supplemental feeds. This is shown very clearly in an experiment, conducted at the Iowa Experiment Station, with the hogs running on timothy pasture and fed corn and supplemental feeds, and another lot on clover pasture and fed corn alone. The summary of the experiment is given below in Bulletin No. 91, Iowa Experiment Station:

Pasture.	Grain ration.	Weight at beginning	Gain per pig	Daily gain	Grain per lb. gain	Grain daily per pig
Timothy	Corn	59.9	103.4	0.923	451.4	4.17
Timothy	Corn 2, shorts 1.....	59.8	125.5	1.120	409.9	4.59
Timothy	Corn 1, shorts 1.....	59.8	133.2	1.180	398.0	4.74
Timothy	Corn 5, meat meal 1...	60.1	138.5	1.237	409.6	5.07
Timothy	Corn 5, tankage 1.....	60.1	153.9	1.374	398.4	5.48
Clover	Corn	59.9	133.7	1.193	416.1	4.97

It will be noted that the gains made on clover pasture and corn were faster than those made on timothy pasture and corn and shorts, but not as fast as those on timothy pasture and fed corn and tankage or corn and meat meal. Based on this data, corn alone fed on a clover pasture is equal to a ration of one-half corn, one-half shorts on timothy pasture, and superior to a ration two-thirds corn, one-third shorts on the same kind of pasture. The value of feeding some grain containing an excess of protein, to hogs on timothy pasture, is shown by the more rapid and more economical gains made by the pigs fed corn and shorts, and corn and meat meal or tankage. The rate of gain was increased 30 to 50 per cent by using a meat by-product, and from 12 to 20 per cent by using shorts with corn.

The above results are borne out by the results secured by the best hog raisers of the state who use bluegrass and timothy for hog pasture. These results are for the time just following weaning when the pig is being started to growing well after being weaned. As the shoat gets larger, it is a good policy to increase the amount of corn and in most cases to decrease the amount of slop fed or to stop feeding it altogether. While in general it gives faster gains to feed a supplement to corn, a pig that has received a ration containing sufficient bone and muscle-forming food until six months of age, will with good pasture do very well until ready for market on corn alone. In order to secure best results with pigs before they are six months old, however, it is necessary, unless a



Chester White Trio

good clover, alfalfa, cowpea, or rape pasture is available, to feed something in addition to corn.

Cowpeas as Hog Pasture.—The cowpea is a quick growing plant and furnishes an abundance of pasture in the fall. It requires 70 to 100 days to mature, and if planted May 15 to June 1, will be ready to pasture by the middle of August or sooner, by which time the pods will be ripening. An acre of well-grown cowpeas turned on when the pods are ripening will often furnish pasture for 15 to 25 one-hundred-pound pigs for from one to two months, and when corn is fed in connection with this pasture the rate of gain is very rapid and the cost of gain very small. For fall pasture cowpeas are more popular in some localities than clover.

One of the greatest uses of cowpeas is in connection with corn to be "hogged down." They can be mixed in the planter box with an early variety of corn and planted with the corn. They can be sown broadcast and covered with a cultivator at the last cultivation, or they can be drilled between the corn rows after the corn is "laid by" with either a one-horse corn drill or a one-horse grain drill. An acre of such mixture has been known to make as high as 1000 pounds of gain on hogs. It requires a season with good late rains, however, to make satisfactory growth with cowpeas in corn and a dry season may result in an unsatisfactory growth of the cowpea.

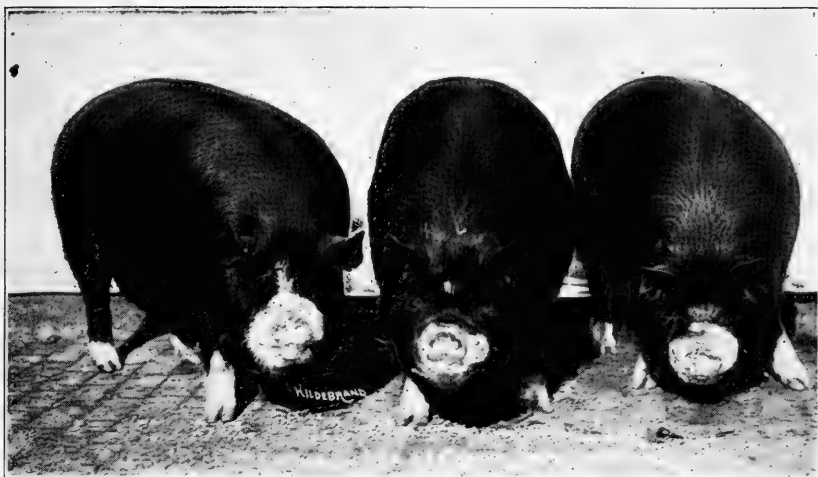
Rape for Pasture.—On the best regulated farms there are times during the year when regular pasture is short. On such occasions a rapid growing plant is in demand. Rape comes nearest to filling the need of any plant available. It has been found to be almost as valuable for producing gain as clover and will be ready for pasturing in about

six weeks after being sown. It can be sown early in the spring and it will endure a pretty severe frost in the fall before it is injured. It is a gross feeder and requires a very fertile soil to make a satisfactory growth. Barn lots are the most common places for growing this plant but it does well on any fertile soil and in corn fields when sown at the last cultivation. It requires a well prepared seed-bed, but can be sown either broadcast or in drills. When broadcasted it requires about 3 to 5 pounds of seed per acre and when drilled about 2 to 3 pounds per acre. It can be sown so as to furnish forage at any time of the growing season, and if necessary can be used as the principal pasture for hogs. It must not, however, be pastured too closely and must be given an opportunity to get well started before being pastured. The amount of land sown to rape need not be large, because it is worthless except for pasture or soiling, and one acre will pasture fifteen to twenty hogs for a period of two or three months.

Oats as a Hog Pasture.—Another plant that can be sown for a time of pasture shortage is oats. Early sown oats will do to pasture early in the spring, when the hogs have to be taken from the rye or wheat. It may also be sown with rape and make more forage than with oats alone, but there is the danger of the oats getting too woody and being trampled down. Oats can be pastured lightly from the time they are three or four inches high, and continued until heads are forming, when the hogs should be removed until the grain is in the milk, when if desirable, they can again be turned in and allowed to harvest the grain crop. Oats are especially good for sows and pigs, and for furnishing early pasture. The composition of the oat plant is such that it does not furnish the proper nutrients to balance a ration of corn alone for growing hogs; hence on oat pasture the hogs should have a limited amount of nitrogenous supplement, such as shipstuff, linseed oilmeal, or a small amount of tankage or meat meal.

Sorghum or Cane.—Sorghum deserves a good place in the list of useful short-lived forage crops for hogs for hot weather and drouths. It is especially useful on account of the large number of hogs it will pasture, furnishing enough forage for twenty to thirty hogs per acre. It is not as palatable and nutritious as the other forage crops mentioned, but is used by many as a dry weather crop. It can be sown in May and be ready for pasture in July. It will last during July, August and September, and often later, and is especially useful during the dry months. The composition of sorghum is also such that it requires a supplement to the corn fed to obtain the best results.

Winter and Early Spring Pasture.—There is probably no greater loss to the hog raisers of the state than the lack of suitable pasture for hogs in winter. Of course, there are times during the winter when it is entirely impossible for hogs to get anything green to eat, but during a large part of the winter the weather is such that it is possible for them to graze upon some kind of pasture. Pasture in winter and early spring serves not only the purpose of furnishing a green feed, but also induces the hogs to take exercise, which they would not otherwise do, both of which will tend to keep the shoats in a healthy, vigorous condition. With some kind of green forage to pick at, pigs will take sufficient exercise



Berkshire Trio

that practically all danger of thumps will be removed. As is well known, two of the worst things that the hog raiser has to guard against in winter are thumps and constipation, both due, to a large extent, to a lack of exercise or some laxative food, and which can be remedied by a green pasture during as many of the winter months as possible. Of course, it is impossible to furnish the best of pasture for three months, from December 15 to March 15, but even during these three months a field of rye, wheat, or bluegrass makes an excellent place for hogs to forage.

For early winter pasture, the succulent forage may do well until freezing weather. Clover, alfalfa, etc., if of good growth may last that long. Rape will make good pasture sometimes as late as Christmas. Cowpeas can be pastured late in the fall, and give a large amount of forage; but from freezing time until grass comes in spring, any green forage for hogs requires a special crop. Rye, wheat and bluegrass are about the only plants that are of much value for the winter months. If the bluegrass has a good growth in the fall it makes excellent pasture in winter and early spring. If pastured close in the fall, however, this grass furnishes little pasture during the winter. Wheat is in general use as a winter crop for pigs, and can be sown at the right time to make a good crop of grain the next summer, and at the same time furnish good pasture in either winter or early spring. Rye is in more general use as a winter forage for hogs than any other single crop. For winter pasture it can be sown any time from August to October, and give good returns. It may be sown in the corn and pastured after the latter is gathered and often good results are secured when it is put in after corn has been hogged down. Rye will make an early start in spring and furnish green feed until clover, etc., will do to pasture, or until some early spring sown crop, such as oats or rape, are ready for use.

One of the worst features about using rye as pasture is that it is hard

to prevent it from mixing with wheat and injuring the latter. It should be sown in a place that is to be plowed up in the spring and planted to corn, so as to kill any rye that may have escaped the hogs. Clover can be sown in rye, and the entire crop pastured. Artichokes also make a good winter pasture when the ground is not frozen.

DRY LOT HOG FEEDING

Feeding hogs when no pasture is available offers one of the greatest and also one of the easiest sources of improvement in the production of pork that can be found by the Corn Belt farmer. Pastures which give variety of feed, laxativeness and needed food nutrients to a ration of corn are not available at all seasons of the year and in a large majority of cases the latter feed is relied upon to give the best and cheapest gains on hogs. Of course corn must of necessity comprise by far the largest per cent of the ration and any other feeds used must be considered as only supplementing corn and not as replacing it. There are conditions under which it is the best policy to use corn alone for hogs even when they are in dry lot, but there are many other times when to use corn alone would be at the sacrifice of time as well as profit.

The factors that determine the value of a ration are: First, the ones that aid in the increase of the feed consumed; and second, the ones that more nearly offer the food nutrients demanded by the animal's body. The importance of increasing the amount of food consumed is readily realized when we consider that the maintenance requirements are very little greater per 100 pounds for a hog that is on full feed than for one that is on a maintenance ration which merely prevents a loss of body weight. If the food consumption is only large enough to maintain the animal, no food would be available for gains. If the food consumed is two pounds daily more than maintenance there would be twice as much available for making gains as if it is only one pound above maintenance. In other words, the feed above maintenance may be compared to the profits above the expenses of running a business. The larger the income above expenses the greater the profit; the greater the food above maintenance the greater and more economical the gains. Although there is a point in food consumption where the digestion is not as thorough as when less feed is eaten, in general the above statement is true.

Chief among the factors influencing the food consumption is the bulk of the feed. The stomach of the hog is of such a nature that a large bulk of feed cannot be consumed. No other animal will make more economical use of the food eaten than the hog but its capacity is not large enough to allow a large quantity to be eaten. Forcing a hog to consume a bulky feed is the same as limiting the ration to the same degree as is the bulk of the feed eaten. No one would think of compelling fattening hogs to consume a large amount of hay or rough feed, yet oats, bran, cob meal, etc., are of somewhat the same nature. Best results cannot be secured with hogs if a very large proportion of bulky feed is used.

Palatability.—Another factor that influences very largely the amount of feed eaten is the palatability of the ration. Careful trials have shown that more complete digestion takes place when the food is well liked by the animal than when it is impalatable. The digestive juices are secreted

in larger quantities when the appetites of the animal are keen and when the desire for food is strong. It is a matter of common observation that animals that do not relish their food are not as thrifty and do not make as rapid gains as others that are not eating any larger amounts of feed but do have a keen appetite. And not only is the digestion better but the actual amount of food eaten by the animal will be larger. This is, of course, one of the essential features and one that will show most marked results. Any feed or mixture of feeds that is very palatable thereby increasing the digestibility and consumption will produce a larger gain on the hogs than a feed of equal food value but not relished by the hogs.

The question of getting the proper food nutrients into a ration can be easily settled, for there are numerous feeds containing the food constituents lacking in corn. The great problem is to find the one that will give the best results for the least cost. This depends, of course, on the amount of each supplement to corn required to balance the ration, and the relative cost of the same. The lower the price of corn, the less is the financial benefit to be derived from the supplement.

When hogs are to be fed in dry lot there is little doubt of the advisability of adding a supplement to corn. This is especially true of small hogs. If the pigs have been well grown on grass or behind cattle, before they are placed in dry lot to finish there is less benefit to be derived from a supplement than if the hogs are young and need growing material. A well grown hog weighing 175 pounds or more will finish almost as well, though not so rapidly, on corn alone as on a mixed feed. Hogs of smaller size (the smaller they are the greater is the effect of the supplement to corn) however, not only make a more rapid but also a more economical gain. Young pigs in dry lot should certainly receive more than corn alone. The question of the proper supplement to use depends for its solution on the conditions as to availability of the different feeds and on their relative price.

Milk.—Whenever this feed can be secured, it must be considered the best supplement to corn for young pigs. Containing as it does all the essentials of an ideal feed for growing animals it can be used to supplement corn for either growing or fattening animals. There is a limit, however, to the amount that can profitably be fed. About one-half gallon of milk to each pound of grain eaten is the amount that should be fed to small hogs. The amount of milk to grain should be gradually decreased until only half as much is being fed when the hogs are finished. Too large quantities of milk especially after the hog has reached some size has a tendency to cause pot bellies. Such conditions should not be permitted. There is practically no difference in the form of the milk, whether whole, skimmed or as buttermilk when fed with corn because the corn supplies the food nutrients removed in skimming. Sour milk usually gives as good results as sweet milk but care must be taken that the souring is not accompanied by decay or bad results will follow.

Tankage and Meat Meal.—These two feeds are so closely related that they may be treated under the same head. They are both a refuse product from the packing houses and are very high in protein and therefore require only a small quantity to balance a ration of corn. An average

of six feeding trials at the Missouri, Nebraska, Iowa, and Indiana Experiment Stations gave the following results:

Ration	Average daily gain	Feed per 100 lbs. gain	100 lbs. gain Cost per
Corn alone .....	.72 lbs.	586.2 lbs.	\$5.23
Corn and tankage.....	1.31 lbs.	427.3 lbs.	4.47

It will be noted that the gain was increased quite appreciably and that the cost of gain was reduced from \$5.25 per 100 pounds in the case of the corn alone to \$4.47 per 100 pounds for corn and tankage. The costs are based on corn at 50 cents per bushel and tankage containing 60% protein at \$44 per ton. These trials were made with varying amounts of tankage and do not show the maximum effect. It should never be fed in greater amounts than one part of tankage to 9 parts of corn and this only for young hogs. For hogs weighing 125 pounds only about one part of tankage to 12 of corn should be used and large hogs do not require a greater proportion than 1 to 15 and very good results are secured by using only one part of tankage to twenty parts of corn.

The tankage or meat meal can be fed either dry or as a slop. When ground feed is used, it should be mixed and fed with the other feed. When only whole corn is used, the tankage can be fed either dry or as a thin slop. In either case, however, a tight trough is needed because a small leakage represents a large per cent of loss on such a small quantity of feed.

Linseed Oilmeal differs very little from tankage in its effect on hogs. It is not as high in protein, however, and requires about double the amount to produce the same results as could be secured if tankage were used. It is not so high in price and is preferred by many feeders because it is free from the disagreeable odor found in tankage and to some extent in meat meal. A summary of four years' work at Purdue Experiment Station to determine the relative value of tankage and linseed oilmeal is as follows:

	Average daily gain. Lbs.	Feed per 100 lbs. gain			Cost per 100 pounds gain
		Corn. Lbs.	Supplement Lbs.	Total Lbs.	
Corn meal, Tankage	1.61	370	24½	394½	\$3.88
Corn meal, Linseed oil meal.....	1.49	364	46	410	4.09

It will be noted that the gains were somewhat less rapid and the grain required to make 100 pounds gain was more when linseed oilmeal was used and that the cost of making gains with corn at 50 cents per bushel, tankage \$45 per ton and linseed oilmeal \$36 was \$0.21 per 100 pounds cheaper by use of the former feed. There is such little difference, however, that the two feeds are considered of practically the same

feeding value. Linseed oilmeal should not be fed in larger amounts than one part of meal to five parts of corn. The proper proportions of oilmeal for hogs of different sizes will be secured by doubling the amount of supplement recommended under tankage. The same method of feeding is employed as when tankage is used.

Shorts or Middlings.—These two by-products of flour mills are so nearly the same in feeding value that they can be considered in the same discussion. They are the most common and abundant of the supplementary feeds for dry lot hog feeding. It requires such a large amount of these feeds to balance a ration of corn that the cost of gains is greater when they are used as the only supplement than when milk, tankage or oilmeal is used. The following table compiled from ten trials at the Missouri and Illinois Experiment Stations gives the effect of adding shorts or middling to corn in dry lot:

Ration	Feed per 100 lbs. gain				
	Average daily gain. Lbs.	Corn Lbs.	Shorts Lbs.	Total Lbs.	Cost per 100 pounds gain*
Corn alone .....	.72	586.2		586.2	\$5.23
Corn and Shorts.....	1.10	333.7	176.4	510.1	\$5.10

*Corn at 50 cents per bushel and shorts \$1.20 per 100 pounds.

It will be noted that the rate of gain was slightly increased and the cost of gain slightly decreased but in the cost the change was not very great. These trials, however, were with hogs weighing about 125 pounds. With pigs, the use of shorts for making a slop especially when mixed with a small amount of tankage or linseed oilmeal gives very much more marked results than when fed to large hogs. In fact, the proper use for shorts in a hog lot is for making a slop for young pigs and as a part of the brood sow ration and also for constituting a part of a slop fed to large fattening hogs when supplemented by other nitrogenous supplements. It adds palatability to a ration of corn and tankage or corn and linseed oilmeal and forms the body of the slop. It may very well constitute one-half of the ration for young pigs but should never constitute more than one-third of the ration for fattening hogs.

Bran.—This feed is too bulky to give best results for fattening hogs. While the composition of the feed is satisfactory for use with corn, the bulk is so great that large enough quantities can not be consumed by the fattening hogs to give rapid and economical enough gains to justify its use in the fattening lot. When the purpose is to grow the animal instead of fatten as in the case of pigs or shoats, bran occupies a place in the ration—sometimes as high as one-third being bran—but otherwise it should be used sparingly, except in the breeding hog's ration.

Oats.—Practically the same can be said of oats as of bran. The bulk is too great to admit of its use very extensively for fattening swine. However, when soaked and fed in small quantities there is a stimulating effect on the hog that is beneficial; but to try to balance a ration of corn with oats would result in giving such bulk to the feed that enough could not be consumed to make satisfactory and economical gains. It cannot be excelled, however, for growing hogs and brood sows. When scattered

on the ground in a clean place or crushed and fed in slop they are an excellent feed for brood sows. And when ground and the hulls sifted out they are the best single feed for young pigs. It is for these latter uses and not for fattening hogs that oats should be employed.

Hay.—It has been in the past considered that hay is too bulky to be of use for hogs, and with a few exceptions the statement is true. However, alfalfa hay, especially the last cutting, cowpea hay and sometimes clover hay can very successfully be used for fattening hogs. Fine alfalfa hay will often be entirely consumed by hogs. If the hay is coarse, the larger stems will be left. The leaves and smaller stems and peas will be eaten from cowpea hay and the leaves and some of the small stems of clover hay if it is clean and bright will be eaten by hogs, especially if they have reached considerable size. Whenever possible alfalfa and cowpea hay and often clover hay should be kept in racks so that the hogs can eat it. Often as high as two or three and sometimes more pounds of hay will be eaten daily by hogs. This feed has been found by experimental trials to practically replace the same number of pounds of corn. From this it can readily be seen that when the hay is of such quality that the hogs will eat it there is a very material cheapening in the cost of making gains. Unless the last cutting and sometimes the next to the last cutting of alfalfa or good cowpea hay is available no such good results can be secured.

Preparation of Grain.—The preparation of the corn for feeding hogs depends largely upon the time of year, size of the hogs and the methods to be employed in feeding. Feeding dry in the ear is the most common and except for special conditions gives as good results as more laborious preparation. When corn is not extremely dry as in summer and it is not desired to feed everything in the form of slop, the ear is the logical method of feeding corn.

Often with spring pigs, the corn is very dry, as in summer, and it is then economy to soak the corn from one feed to the other or for 24 hours. The grain is thus softened and rendered more palatable and a greater amount eaten. There are very few years when corn does not become so dry in summer that it does not pay to soak it for young pigs. This is also the case sometimes with large hogs and also at other times of year. Trials have shown that about 5 per cent is added to the feeding value of corn by soaking it. The gain is slightly more rapid and slightly cheaper. This does not, of course, apply to corn that is not dry.

Grinding corn for young pigs does not pay for the trouble, unless the meal is being mixed with other feeds to form a slop. When a mixed feed such as corn, shorts and tankage is being fed it is more convenient and more profitable to grind the corn and mix all feeds together. With this exception it does not pay to grind corn for small hogs. For larger hogs grinding has proven by a great number of trials to add somewhat to the efficiency of the ration. The average of 18 trials at the Wisconsin Experiment Station showed that 6 per cent is added to the efficiency of corn by grinding. This added value to corn by grinding is not usually enough to pay for the cost incurred in such preparation unless very rapid gains and a quick finish are desired, or other feeds are being used so that it is desirable to grind and mix all feeds together before feeding.

Modern Systems of Swine Management

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High priced farm lands, which as a rule are less fertile than formerly, are demanding that more attention be paid to modern methods of farming. If agriculture is to be permanent, then the fertility of the soil must be, at least, maintained if not increased. In order to economically keep up this fertility, it is a recognized fact that some kind of live stock must be kept. The demand of the meat eating public makes it imperative that a large part of the live stock produced on the farm be cattle, sheep or swine. The kind of animal to be kept is determined by a good many different factors of which the following are some of the most important:

First: The kind of farm, or in other words, the kind of food available. It is easily understood that no man could grow hogs profitably on the large grazing areas of the West or on any farm where grain could not be readily supplied. As a country develops, the beef and sheep industry gives way to a certain extent to the dairy cow and hog for the reason that dairy and pork production adapt themselves better to intensive farming than does the production of beef or mutton.

The next thing to be considered is the relative efficiency of the various animals for utilizing the feeds grown on the farm. No other meat producing animal, with the possible exception of very young lambs, will make as economical use of food given as will swine. This is shown by a table given in Jordan's "Feeding of Animals," the data of which was obtained from the recorded data of experiment stations involving a number of observations and hence should be reliable for average conditions. A part of the table follows:

Kind of animal	No. of experiments	No. of animals	Digestible organic substance to produce one lb. increase in live weight
Steers (average)	32	242	7.40
Sheep (avg. for sheep and lambs)	11	122	7.20
Swine (average)	277	1,385	3.29

If the above results are trustworthy, it is seen that a little more than one-half as much digestible organic matter is required to produce a pound of gain in live weight of swine than in case of cattle or sheep. (In this connection it is conceded however, that cattle and sheep are able to utilize a greater amount of roughness than can the hog).

Nor does the food required to produce a pound of live weight tell the whole story. Another part of this same table shows the food requirements to produce 1 pound increase in carcass and also the requirement to produce 1 pound increase in edible solids.

Kind of animal	Digestible organic substance producing	
	One pound increase in carcass	One pound increase edible solids
Steer	12	36.3
Sheep and lambs	14.2	37.9
Swine	4	6.4

This table goes to emphasize the fact which we already know, i. e., that swine will dress out a much higher percent than either sheep or cattle and also that a larger per cent of the swine carcass may be utilized for human food. So far, then, as economy of production is concerned, we see much in favor of swine when compared with cattle and sheep.

A third consideration, as to kind of animal produced, would probably be the supply and demand. In other words, we must be able to obtain the animals which we can finish into a marketable product and must have a demand which will enable us to sell the finished product at a price which will give us a profit. Owing to the prolificacy of swine, there is no class of animal which is easier obtained. A small number of brood sows will produce a large number of animals to feed. The capital needed in order to start in the business is for this reason relatively small. As to the demand for the finished product, the past statistics show that pork has sold for as high or higher price per pound than either beef or mutton. The facts already given show this to be the logical result. Pork is getting to be more and more the meat used by the working class of people and for this reason we may conclude that the demand for pork will continue.

The kind of animal to be produced is also determined, more or less, by the present prospects of the industry. Probably the greatest drawback of the industry in the past has been the dreaded disease of hog cholera. Since much progress has been made in the last few years in methods used to control this disease, it would seem that it should be only a question of time and education until the danger from hog cholera should be reduced to a minimum.

By the facts already brought out, namely: the trend towards intensive methods of farming; the economy of production, including both the cost and the food value of the product; and the demand for the finished product it is shown that there are some fundamental reasons why the swine business is profitable compared with other meat producing industries.

As a country develops, land increases in value and it becomes necessary to change the systems of farm management and farm practices. It has been shown that pork production is profitable. It is not, however, as profitable as formerly unless modern systems of management are followed. For example: conditions were formerly such that it was profitable, as well as desirable, to market extremely heavy hogs. In the case of swine, however, as well as with other meat producing animals, early maturity and short feeding periods are now the rule, so we find few prime heavy hogs (350 to 500 pounds) reaching the market. It is only by adopting the system of management to changing conditions that the hog feeder can make the most out of his operations.

Owing to the different kinds of farming there are several more or less well defined systems of swine management, each requiring to a certain extent, its own specific practices. For example, a system which is well adapted to farms having good equipment and on which is grown a large amount of grain, is that of keeping on the farm a breeding herd large enough to produce all the pigs needed for feeding. These sows are bred to produce, as nearly as possible, two litters a year. The pigs produced in this way should be crowded from birth and are marketed at from 6 to 8 months of age at 200 to 250 pounds.

A second system is that of raising but one litter a year and having this litter come during the late spring. The sows and pigs are on forage of some kind for the grazing season with perhaps a small amount of grain in addition. The pigs are in this way grown, rather than fattened, until fall. At this time they are large framed, muscular hogs and are put on feed and finished for spring market at the age of 12 to 14 months.

A third system practiced by some is one very much like the second except that the hogs are on pasture with little grain during the first summer; are fed a growing ration during the winter, and during the second summer, or when the hog is a yearling he is provided forage crops such as alfalfa, clover, rape, etc., and grain enough to finish him by the end of the grazing season. These are marketed in the fall at a weight of 300 pounds or more.

Other more or less distinct systems might be mentioned. Each has its advantages and disadvantages and the one practiced depends very much upon local conditions. The best system for one man may not be the best for another. The system best adapted for a given individual one year may not be the best for the year following. It is impossible, therefore, to say that any one system is best for all conditions.

Regardless of the particular system of swine management which is practiced, however, certain principles must be kept in mind and followed in order to make risk from disease small, cost of production low and selling price as high as possible.

The object of what follows is to supplement, somewhat, the information furnished in the preceding chapter by Mr. King, upon improved methods of feeding, housing, control of disease, etc., and to outline a general plan or system of management which will be adapted to and put into practice, the principles of which make for increased profits.

One of the first principles which should be observed with any kind

of live stock, in order to advance, is that of handling improved types. Many years of breeding a type, for a particular purpose, has resulted in the production of animals which are more efficient machines. The improved dairy cow, for example, is a more efficient producer of milk and butter than is the unimproved animal. She can take the raw product and from it more economically produce milk and butter. The same thing is true of meat producing animals. Years of breeding has produced a type of animal which will make a much more valuable carcass with no greater cost.

The profit made from pork production is the difference between the cost of producing the hog and the selling price. The improved type of hog is highly developed over the back and loin, is heavy in the hams, is light in offal, etc., and hence commands the better price. In order to increase the profits then, a better type of hog should be used. It is not enough to simply make pounds of pork but it must be pork of the right sort.

Generally speaking, it is profitable to produce on the farm the pigs to be fattened, since this gives the feeder much greater control over the type of animals handled. Better sires and dams mean that the offspring will be a better type of pork hog. It is very important that great care should be exercised when selecting the sire since this influence for good or bad, in the herd, is relatively much greater than is the case with a single dam. The dams should, of course, be of the best type which one can afford but it is apparent that where polygamous mating occurs that it is good business to improve the herd through the sire, rather than through the dam.

Another advantage to be had by producing the pigs to be fed is that usually the younger the animal the cheaper the cost of gain. The younger the pig the less feed is required for each pound of pork produced.

Not only should the breeding animals used be of the improved type but they must be maintained cheaply and efficiently since the cost of the pig at weaning time depends to a large extent upon this. The fact that corn alone is not an ideal swine feed, due to its lack of muscle and bone building nutrients, has already been mentioned. Experiment stations have shown that corn should be supplemented when fed to breeding swine for two reasons:

- (1) In order to cheapen the ration.
- (2) In order to increase its efficiency.

In other words, the addition of some feeds like tankage or linseed oil meal, which are high in protein and ash, to a corn ration, decreases the actual cost of maintenance. It has been further shown that when sows were fed a properly supplemented ration that their litters were larger in weight and stronger in every way. This is what could logically be expected, since in addition to supplying the actual food nutrients needed, for developing the pigs in utero, the sow is herself kept in the proper condition physically.

While it will decrease the cost of maintenance to add a grain supplement to the corn ration, the cost may be still further decreased by making the supplement a leguminous pasture or hay. As a matter of fact, such crops as alfalfa, clover and rape have several advantages over the



Rape Is One of the Most Profitable Pasture Crops

high priced grains. In the first place they are cheaper. They are also more efficient, since they supply the bulk and succulence demanded in the ideal ration for breeding animals. They are a great help in maintaining the health of the breeding herd, since the hogs are in this way induced to take exercise and they also make it possible to scatter the hogs over a larger area, the importance of which has already been discussed. Then the result of being able to make better use of the manure furnished must also be kept in mind. If the above suggestions regarding the feeding of the breeding herd are followed, much will have been done toward decreasing the cost of the pig at weaning time.

The question of feeding is not the only consideration at this time, however. Careful management during the breeding season, care of sow while pregnant and at farrowing time, the care of the sow and litter and the successful weaning of the pigs, all have an important bearing upon the matter.

The successful management of the pigs up to weaning time probably calls for more skill than any period during the hog's life. The expensive part of the process of pork making, however, is from weaning time until they are marketed. This is true or the reason that as the shoats are fed longer and as they become larger and fatter they require much more feed. The cost of fattening depends upon several factors, some of the most important are: (1) the quality of the hogs, (2) the age or weight, (3) the time of year, (4) the kind of feeds used, (5) the method of feeding.

Kind of Hogs Used.—The importance of using the best type of hogs

has already been taken up somewhat in detail so it is perhaps not necessary to discuss the matter further. The same thing is true in regard to the question of age or weight. It has been brought out that the most profitable feeding is the one which is produced by using only hogs of improved breeding, and that the younger the hog ordinarily the cheaper are the gains. It should be always borne in mind however, that regardless of the quality or the age of the hogs, they should be kept in the best of health and thrift, if economical gains are to be secured. This means keeping the herd free from lice and worms, and supplying a conditioner of some kind in order to keep the bowels of the hogs in proper condition. Methods of doing this are discussed in the preceding sections.

Time of Year.—As a rule, most feeders find that the most economical gains are put on during spring and early summer and during late summer, fall and early winter. This merely emphasizes the importance and value of making the hog comfortable and argues strongly for adequate quarters in winter and summer. If the hogs have proper shelter from the extreme cold and heat the gains put on in winter and summer would, no doubt, approach, in economy, those put on during the other seasons of the year. The hogs must be comfortable to do well.

Kind of Feed Used.—There is perhaps nothing which controls the cost of gains so much as does the kind of feed used. There are two ways in which the cost of gains may be decreased during the fattening period: (1) by feeding more economical grain rations and (2) by the substitution of forage crops for high priced gains.

The grain fed to hogs may be divided into two classes: those like corn, wheat, rye, barley, oats, kafir corn, etc., and which are termed carbohydrates. This class economically furnishes the nutrients necessary to supply energy and the material from which the fat is produced. The other class is called protein feeds and is used by the animal to produce muscle and bone. Examples of protein feeds are feeds like tankage, linseed oil meal, middlings, bran and skim milk. In order to feed economically these two classes of feeding stuffs must be combined in the proper proportion in order to supply the nutrients needed by the hogs. However, since there are several different feeds under each class it is necessary to know the relative feeding value of each in order that, taking price into consideration, the one may be used which gives the most for the money expended.

CORN SUBSTITUTES

In the past relatively little attention has been given to the feeds used to supply the carbohydrate part of the ration, since corn was, without question, king in this respect. Taking the price per bushel, and the feeding value into consideration, corn was a more efficient fat producing food than any other similar grain. In other words, the problem of selecting an economical ration consisted merely in selecting a protein supplement to feed with corn. The relatively high price of corn during the last few years, however, has complicated the matter somewhat, so that a corn **substitute** was of interest as well as a corn **supplement**.

In many sections it often happens that wheat is cheaper than corn and this is perhaps the grain most commonly used as a corn substitute.

Early experimental work comparing the feeding value of these two feeds furnished some data upon the subject. This work, however, was carried on some time ago and the experiments were, for the most part, with wheat alone and corn alone. In some of the early tests a low grade or frosted wheat was also used which made the data obtained hardly comparable with results obtained from the use of a good grade of grain. The conclusions drawn from the early experiments were to the effect that corn and wheat have about the same feeding value. Until recently no data was available to show the results of a combined ration of corn and wheat or a wheat ration supplemented with some feed high in protein and ash. The Missouri, Nebraska, Kentucky and Ohio stations have recently obtained data which furnishes much more complete information upon the question of wheat feeding.

The Missouri Station (Bulletin 136) compared the following ration:

- Lot I.....Wheat
- Lot II.....Wheat and corn equal parts
- Lot III.....Wheat 5 parts; corn 5 parts; tankage 1 part
- Lot IV.....Wheat 10 parts; tankage 1 part
- Lot V.....Corn 10 parts; tankage 1 part
- Lot VII.....Corn

The grain was fed ground in all cases. In these trials, wheat alone proved more valuable than corn alone. For example: with corn at 60 cents per bushel, wheat was worth 77 cents; with corn at 70 cents, wheat was worth 90 cents; with corn at 80 cents per bushel, wheat was worth \$1.03; and when corn was worth 90 cents, wheat gave a return of \$1.16.

If the results obtained by all of the stations feeding wheat and tankage be summarized, it will be seen that they indicate that for best results it is necessary to feed some tankage along with wheat, at least during the early part of the feeding period.

The above shows then that wheat is an excellent substitute for corn and that it should be used in this way rather than as a supplement.

While comparatively little experimental work is available showing the feeding value of rye and barley, they are considered as having about equal feeding value and as ranking somewhat below wheat as swine feeds.

The Kansas Experiment Station has found that kafir meal has a feeding value of from 17 to 29 per cent less than corn meal. The addition of a protein supplement is also recommended when kafir is used.

The high percentage of fibre makes oats rank rather low as a substitute for corn for fattening hogs. The Ohio Station found that it took 495.7 pounds of a ration of oats 9 parts, tankage, 1 part, to produce 100 pounds gain as compared with 418.0 pounds of a ration of corn 9 parts and tankage 1 part.

Both the Indiana and Ohio Stations have experimented with hominy feed as a substitute for corn and their results indicate that the hominy feed has a somewhat higher feeding value than corn, hence, may be used as a substitute for corn when the price permits.

CORN SUPPLEMENTS

With feed as high as it now is the question no longer is, shall a supplement be used but rather which one is the most economical and

while as stated above the high price of corn has made it necessary at times to consider the use of a substitute, the important question will ordinarily be that of deciding upon a protein supplement.

The matter of protein supplements has been discussed in detail in the preceding section so will only be considered briefly at this time. The question of the relative price and efficiency will, of course, determine the one to be used. Analyses of feeds show that where 10 pounds of (first grade or 60%) tankage is required to balance 100 pounds of corn that it takes about 25 pounds of linseed oil meal; 170 pounds of middlings; 200 pounds of skim milk; 26 pounds soybean meal; or 140 pounds of alfalfa hay. The above figures give a good idea of the relative efficiency of these different feeds when used as a supplement.

FORAGE CROPS

Much may be accomplished toward cheapening the cost of production by selecting the most economical grain rations. With the very best grain rations, however, the profits from feeding hogs are not as much as formerly so a method of feeding has been sought which will still further decrease the cost of gain made by fattening hogs. It has been shown that this may be done by the use of a forage crop.

The Missouri Experiment Station has carried on extensive experiments along this line. The following table emphasizes the economy of forage crops:

ECONOMY OF FORAGE CROPS

Kind of forage	Pounds of grain per pound gain	Pounds gain per bushel corn fed	Value of pork produced per bushel of corn fed on forage—6c pork at
Bluegrass	4.50	12.4	\$.74
Alfalfa	3.07	18.2	1.09
Clover	2.95	18.9	1.13
Rape	2.74	20.4	1.22
Rape and Oats.....	3.60	15.5	.93
Rape, Oats and Clover.....	2.47	22.6	1.36
Sorghum	4.00	14.0	.84
Cowpeas	3.58	15.6	.94
Soy Beans	3.00	18.6	1.12
Rye Grain	1.96	28.5	1.71
Average	3.18	18.4	1.10

The above table shows that on forage it required an average of only 3.18 pounds of grain to produce 1 pound of pork, as compared with 5.11 pounds, the average from the dry lot feeding trials conducted under similar conditions. This would mean a saving of 38% in the amount of grain fed. The average return per bushel of corn when fed to hogs grazing on forage crops was \$1.10. The average return per bushel on corn fed in dry lots was 66c.

Likewise, the Iowa Experiment Station has results which show that pigs pastured on alfalfa returned a profit of more than \$3 per head with corn at 50c per bushel and hogs worth \$6 per hundred. The same year hogs fed in dry lot return a profit of only 61c per head.

Other experiment stations have similar data, such figures, however, do not tell the whole story. The value of pasturing off the crop and by



Hogs Do Their Own Gathering and Save Expense

so doing, returning the larger amount of fertility, must not be overlooked. It is also claimed by many that hogs pastured during the summer on forage and then finished in dry lot make greater gains in the dry lot than those grown through the summer in a dry lot instead of on forage. In other words, it is thought that there is a residual effect from the forage crops which is beneficial when the hogs are later finished in dry lot.

Then there is the still further advantage of supplying succulent feed which keeps the hog in the best physical condition. The fact that the use of pasture crops aid still further in controlling disease by making possible much more sanitary conditions and help keep the herd free from lice, worms, etc., are also important considerations.

While pastures in general are good, there are some which give larger returns than others. Alfalfa as a swine forage ranks at the very top. This is true for several reasons. It has a long growing season and hence furnishes pasture early and late. It is drouth resisting, growing luxuriantly when many other crops cannot grow for lack of moisture. The composition of the plant also makes it especially fitted for balancing a corn ration.

Clover ranks next to alfalfa perhaps as a hog pasture. Its composition is very similar to alfalfa, however, it cannot be pastured as early nor will it maintain as many hogs per acre as alfalfa. The crop fits well in Corn Belt rotations and may be very profitably harvested with swine.

The best annual hog forage is without much question to be had by seeding as early as possible in the spring either a field of Dwarf Essex rape or a mixture of rape and oats. The rape may be broadcasted at the

rate of 6 pounds seed per acre and then followed with a grain drill using one bushel of oats per acre. There is no annual forage which will produce more pounds of pork per given area than will rape and oats. This crop has given excellent results when compared with other hog pastures by the different experiment stations. Your experiment station can supply you with more detailed information concerning it.

Bluegrass and sorghum are also to be recommended. Bluegrass comes early and late, but takes a rest during the hot dry summer. A field of sorghum is very valuable for this hot dry spell when other crops are not doing much growing.

The most progressive hog raisers recognize the importance of having green feed as much as possible and are planning to have **all year hog pasture**. Wheat or rye sown early in the fall and bluegrass will give winter and early spring pasture. It is surprising how much winter pasture may be obtained with wheat and rye and by saving a field of bluegrass for use in winter. Alfalfa, clover and bluegrass may be used in the spring after rye is turned under until the rape and oats are ready. Several different fields of this crop should be sown in order to make it possible to change from one to the other and thereby let them freshen. (Rape will come on again if not grazed too closely.) As mentioned above, sorghum gives good results for the hot summer. When cool weather comes and fall rains begin the rape and bluegrass again produce a large amount of forage.

If the fattening shoats on forage are fed, as indicated above, they will ordinarily not be finished at the end of the grazing season but they will be in excellent condition to be finished economically by allowing them to hog down some corn. In planning a rotation of crops, then, it is a good practice to include enough corn for hogging down to finish out the hogs grown through the summer on forage.

HOGGING DOWN CORN

That the practice of hogging down corn is a good one has been shown by tests carried on at many experiment stations and has been demonstrated in actual practice by a large number of feeders.

Eleven trials with hogging off corn at the Missouri Station have shown that there is no better way of finishing hogs than by allowing them to do their own harvesting. This was true considering both the rate and economy of gains.

Some of the advantages of hogging down corn are well summarized by the Iowa Station as follows: (Bulletin 143)

(1) Labor is saved. Four handlings of the corn crop are omitted, namely: (a) husking, (b) cribbing, (c) reloading, shoveling into wagon at a later feeding time, (d) feeding the hogs on pasture or at the yards. These enumerated handlings of the corn crop are modified under local conditions; some simply take the load of corn from the field, if they have an extra wagon, into the hog lot and feed it out there, thus doing away with cribbing and reloading.

Two handlings of manure are discounted. The manure is dropped in the fields where it is needed, no labor is necessary to haul it out of

the lots and to scatter it. Any animal such as the hog, or device such as the self-binder, the corn husker, or gang plow is welcome under the present existing labor conditions: "Hogging down" has been pressed into service largely because of the extenuating difficulties arising in the securing reliable efficient help to harvest the corn.

(2) Storage charges are saved upon the portion of the corn hogged inasmuch as crib space is not needed. The rats and mice do not get any of the corn that is "hogged down".

(3) Returns are equally as good in pork produced where the hogs gather their feed themselves as where it is hand-fed. It is proposed of course that some pasture or supplement be fed in conjunction with the corn in field as well as in dry lot feeding. Hogs running in the cornfield and having alfalfa, rape or clover pasture in addition with possibly a little supplement depending upon the pasture used are ideally handled to secure a maximum of pork at a minimum expense. The hogs gain more economically and rapidly when in the corn-field properly supplemented than they do in dry lot.

(4) The hogs develop good constitutions with considerable strength and are in excellent condition for quick fattening feed after coming out of the field. Range with its accompanying exercise provides a most excellent tonic; the hogs are healthier than in dry lot feeding and are especially inclined to stretch and develop in the corn field, building frame and muscle to a large degree, putting them in good shape for a few weeks close-pen fattening.

(5) No manure is lost, practically speaking, as in dry lot feeding; of course this does not apply to pasture. Animal husbandry has not yet been able to devise a system of manurial fertility, conservation which would excel the "hogging down" way. With the almost entire lack of leaching loss we have only that fertility removed from the land which is carried away in the hog's body; which really comprises only a small portion of the corn crop's fertility.

(6) The manure is evenly and uniformly distributed over the field in such a manner as to do the most good without the intervention of human labor. Hogs easily excel the modern mechanical manure spreader. These manurial advantages of "hogging down" mean increased yields as compared to the elevator way of handling the corn crop.

(7) The crop is harvested without waste; the hogs if rightly managed picking up practically every stray kernel of corn. By following up the fattening hogs with young shoats or even with brood sows, the field will be garnered more closely than it would be by the ordinary husker. In truth the hogs turned into the field after the husking is over pick up considerable corn which might otherwise go to waste.

(8) The weeds may be cleaned up to some extent. One man especially says, "Quack grass has disappeared permanently since I started 'hogging down.'". One would not ordinarily expect such a happy result as this but nevertheless considerable of the weeds are destroyed.

(9) Hogs may follow up cattle and otherwise save waste. They may clean up after silo filling time, gathering the ears which have been dropped by the corn binder, they may follow the husking machine and garner the waste grains.

(10) Facilitates and encourages the gathering of seed corn early from the standing corn in the field. One practical man puts it this way: "The reason many men do not gather their seed corn early is because they do not like to 'smash' down the rows with a wagon and carrying a sack is tedious, discouraging, sticky business..... With us in half a day two men with team and wagon gather enough seed to plant a hundred acres..... We then turn the hogs in and they efficiently do the rest with much profit resulting directly and indirectly."

(11) Poor stands of corn may be taken advantage of in that rape may be sown at the last cultivation, thus enabling the land to produce a full crop that season; the hogs do the rest.

(12) Brood sows which are to farrow spring litters may be advantageously run into the field after the fattening or other hogs are removed; they gain health from so doing, thriving under the tonic of invigorating exercise and beneficial range.

(13) Fall plowing is sometimes possible if the hogs clean up the field up early, thus preventing rush of spring work.

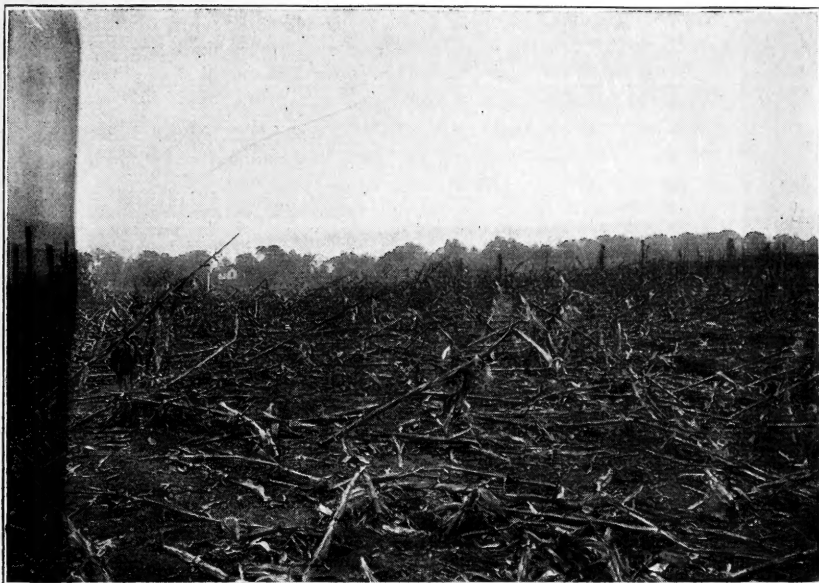
(14) Organic plant matter will be largely added to the land if supplementary crops such as rape, rye, soy beans and cowpeas or the like are sown in the cornfield. The rape stumps as well as the mat of material left from rye or soy beans will discourage washing and erosion to some extent. The "hogged down" stover reverts more quickly to the desirable manurial and fertilizing form of organic matter than does the hand-husked. Quick and speedy incorporation of crop residues into the soil is quite desirable.

(15) Corn is harvested more quickly.

If such a practice is to be most profitable it must, as in the case with any other method of harvesting, be rightly managed. For best results the hogs should not be given access to the entire field but should only have the run of what they will clean up in ten days or two weeks. If the hogs are limited in this way they will have fresh forage from time to time and will clean the field up much better as they go. For this purpose some kind of a movable or temporary fence must be supplied. A cheap and efficient temporary fence may be made with woven wire by fastening well at each end and then tying to the corn stalks.

Before placing the hogs on the corn they should be gotten on full feed of new corn gradually by starting them on a few stalks and increasing until they are getting about all they will clean up. They may then be placed in the field to do their own harvesting. The hogs should be turned into the corn field when the dent has just formed in the kernel. They will do better at this stage than if the corn is allowed to get harder. For profitable results it is of importance to supply an abundance of water to hogs on a full feed of corn.

The question of a supplement to the corn which is "hogged down" is one of importance. In sections where crops like rape, or soy beans may be successfully grown in the corn, a grain supplement is perhaps unnecessary. When such crops are not grown it will no doubt pay to feed in addition a small amount of some supplement, like tankage. For this purpose one-fourth to one-half pounds of tankage per 100 pounds live weight per day should give good results. The tankage may be fed either dry or wet in a trough. The Iowa Station reports good results by feed-



After Field Has Been Cleaned Up

ing tankage in a self feeder and allowing them to eat it at will. Their results indicate that the hogs will balance their ration about right.

SELF-FEEDERS FOR FATTENING SWINE

This brings up the question of the use of self-feeders for fattening swine. The Iowa Station has perhaps done more experimental work along this line than any other station. Among other trials they conducted one where several feeds were placed in separate self-feeders and the hogs allowed to eat as much of each as they desired. The following feeds were used:

- Shelled corn
- Wheat middlings
- Meat meal (60% protein) stankage
- Whole oats
- Linseed oil meal
- Charcoal
- Ground limestone
- Common rock salt
- Water

They found that pigs weighing about 45 pounds at the beginning of the trial, when fed as indicated above, weighed around 290 pounds at the end of the 162-day test. During this time, for each 100 pounds gain, they ate the following feeds:

Shelled corn	372.40	pounds
Meat meal	27.57	"
Oats	2.53	"
Oil meal	1.15	"
Middlings	14.54	"
Charcoal .....	.10	"
Limestone .....	.14	"
Salt .....	.13	"
Total	418.55	pounds

The above shows that corn, meat meal, and middlings were the feeds mostly used by the hogs when allowed to eat each at will. The gain obtained was quite satisfactory both as to rate and economy.

The Missouri Station fed two lots of hogs averaging in weight at the beginning about 110 pounds, 56 days on a ration of corn 12 parts, tankage 1 part. One lot was hand fed and for the other a self-feeder was used. The results from this trial show very little difference, either as to rate or economy of gain, indicating that the use of the self-feeder for fattening hogs was as satisfactory as hand feeding.

The Minnesota Station reports as follows upon the results of three trials where the method of self-feeding was compared with hand feeding for fattening swine.

"In all three tests, the self-feeder pigs ate more grain per day, and their daily gains were somewhat larger. On the other hand, the hand fed pigs produced a little more pork for each pound of grain consumed. The self-feeder, then, gives a little faster gains but requires slightly more feed for a given gain."

The above experimental work indicates that self-feeders may be used satisfactorily for fattening swine. It can be used, of course, only when it is desired to full feed.

CONCLUSION

As stated before the profit is the difference between the cost and the selling price. All of the above discussion has had to do with methods of decreasing the cost of production and it is here that the producer can do the most to increase his profits, since he has relatively little control over the selling price. It is important, however, that he be well posted as to the demands and conditions of the market in order that he may sell to the best advantage. He should be familiar, for example, with the market classes and grades of hogs in order to properly interpret market values. He should keep thoroughly posted upon variations of the market caused by economic conditions, time of year or any other cause.

If he does all this he should be able to intelligently sell his product which if produced in the cheapest possible way should mean the largest possible net profit.



Missouri's Greatest Farm Pap



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